JANUARY, 1934.

GENERAL PHYSICS.

ADSORPTION.

1. Adsorption and Surface Tension of Strong Electrolytes. S. Oka. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 407–412, *Nov.,* 1933. *In German.*—In a previous paper [see Abstract 4004 (1932)] the author derived, on the basis of the Debye-Hückel theory, an expression for m in the equation for dilute electrolytes $\sigma = \sigma_0 (1 + mc)$, where σ and σ_0 = surface tension of solution and solvent respectively, and c the concentration of the solute. In the present paper the same expression is derived without special assumptions on the basis of the Gibbs adsorption relation. The theory is extended to cover concentrated solutions. P. H. B.

2. Surface Condensation. N. Fuchs. *Phys. Zeits. d. Sowjetunion,* 4. 3. *pp.* 481–487, 1933. *In German.*—Frenkel's theory of surface condensation, which requires the existence of a sharply defined critical temperature on condensation, is criticised. The latest experimental data of Chariton, Semenoff and Schalnikoff [see Abstract 3468 (1932)], which refute the existence of such critical temperature (or critical density) and were considered by these authors from the standpoint of surface irregularity, may be satisfactorily explained on the basis of the Gibbs-Volmer theory of condensation processes. T. H. P.

3. Statistical Derivation of Adsorption Isotherms for Binary Gas Mixtures. G. Damköhler. *Zeits. f. phys. Chem.* 23. *Abt.B.* 1–2. *pp.* 58–68, *Oct.,* 1933.—These isotherms have been statistically derived by the Gibbs method for the case of the monomolecular covering of a homogeneous surface neglecting the intermolecular forces in the adsorption layer. No special assumptions concerning the motion possibilities of the particles in the adsorbed phase have been made. The temperature dependence and functional relationships of the coefficients occurring in the expression for the isotherm are given by their relationship to the state summations of the particles in the gaseous and adsorbed phases. For special types of motion, the calculations were made by the classical methods. The isotherms are discussed with respect to concentration, pressure, and temperature dependence. In binary gas mixtures, the concentration dependence is clearly a preferential adsorption of one of the components, whilst pressure change is without influence on the composition of the adsorbed phase for constant composition of the gaseous phase. The temperature dependence is bound up with the adsorption potentials, and the selectivity of the adsorption varies accordingly. The paper is mathematical. H. H. Ho.

4. Adsorption of Nitrogen-Argon Mixtures. G. Damköhler. *Zeits. f. phys. Chem.* 23. *Abt.B.* 1–2. *pp.* 69–88, *Oct.,* 1933.—The adsorption isotherms of nitrogen and argon as well as of their mixtures have been determined for silica gel, as adsorption medium, at 89·5°, 111°, and 163° K., under pressures between 100 and 700 mm. Hg, and have also been measured for norit-charcoal both when gas-free and when charged with CO_2 at 111° K. and 250 mm. Hg. The experimental data indicated a preferential adsorption of the nitrogen in the first adsorption layer. The data also enabled some general conclusions to be drawn with respect to the pressure and temperature dependence of the adsorption of gas mixtures. In the first layer, nitrogen possesses approximately a 200 cal. greater adsorption potential than argon. Earlier work in this field is also discussed.

H. H. Ho.

5. Adsorption of Thorium B by Thallium Halide Crystals in Presence of Various Ions. Part II. J. F. King and P. R. Pine. *J. Phys. Chem.* 37. *pp.* 851–874, *Oct.*, 1933.—Adsorption of ThB on thallous bromide and iodide has been measured with special care. The purest salts have a negative charge due to preferential adsorption of the halogen ions. Adsorbability of I, CrO_4, CNS, Br, PO_4, Cl, C_2O_4 ions is in inverse order of their solubility. Effects due to the presence of Ag, Cu″, Tl′, and Pb″ ions are also recorded and the variation of the amounts of adsorption with H-ion concentration. [See Abstract 3873 (1933) and following Abstract.]

A. S. C. L.

6. Adsorption of Thorium B by Silver Bromide Crystals in Presence of Various Ions. Part III. J. F. King and U. T. Greene. *J. Phys. Chem.* 37. *pp.* 1047–1059, *Nov.*, 1933.—A study has been made of the adsorption of thorium B ions on silver bromide crystals in the presence of various concentrations of the alkali and alkaline earth bromides. It has been shown that when the bromide ion concentration has been kept constant and the kation has been changed there has been a change in the adsorption of the thorium B ions on the silver bromide crystals due to an adsorption of the kations along with the thorium B ions. There appears to be a relation between the adsorbability of the kations and their heats of hydration, their ionic size and the solubility of their bromide salts. [See preceding Abstract.]

AUTHORS.

See also Abstracts 23, 360, 361.

ATOMIC AND MOLECULAR STRUCTURE.

7. Application of Pauli's Principle to Nuclei. W. M. Elsasser. *J. de Physique et le Radium*, 4. *pp.* 549–556, *Oct.*, 1933.—The possibility of the nuclei of light elements being constructed entirely from neutrons and protons is suggested. A construction consisting of a series of neutron and proton envelopes is proposed and the provision of quantum numbers for the particles is discussed. It is claimed that this construction is capable of providing an explanation of more nuclear properties than is a structure containing α-particles. The fact that nuclei can emit α-particles is met by the hypothesis that these are formed just before emission takes place. An estimate is formed for the energies which would be expected in such a system and very high values for the potential energy are estimated, *e.g.*, 30×10^6 electron volts for a proton.

J. E. R. C.

8. Heights of Nuclear Potential Barriers. E. W. Pollard. *Phil. Mag.* 16. *pp.* 1131–1141, *Dec.*, 1933.—The experimental evidence on the heights of nuclear potential barriers is collected and values found for seven light elements. It is shown that these values are a linear function of the corresponding atomic number. An explanation of this is suggested on the basis of Heisenberg's nuclear theory, and it is shown that a constancy of the critical radius of nuclei follows from the approximate equality in the numbers of neutrons and protons in the light elements, and that this accounts for the experimental rule.

AUTHOR.

9. Artificial Disintegration of Atomic Nuclei. F. Kirchner. *Phys. Zeits.* 34. *pp.* 777–786, *Nov.* 1, 1933.—Detailed historical account of the artificial disintegration of atomic nuclei by positive ion bombardment. New photographs obtained by the expansion method are presented. F. C. C.

10. Manganese Isotopes. Irene G. Otto and Edna R. Bishop. *Am. Chem. Soc., J.* 55. *pp.* 4371–4372, *Nov.*, 1933.—Investigation by the magneto-optical method shows the existence of seven isotopes of manganese, three being lighter and three heavier than the most abundant of atomic weight 55. T. H. P.

11. Isotopes of Sodium and Cæsium. C. B. Dollins and Edna R. Bishop. *Am. Chem. Soc., J.* 55. *pp.* 4372–4374, *Nov.*, 1933.—Investigations by the magneto-optical method shows that sodium has three isotopes, one heavier and two lighter than 23, and that cæsium has six isotopes, three being lighter and two heavier than 133. T. H. P.

12. Covalency, Coordination and Chelation. R. C. Menzies and H. Overton. *Chem. Soc., J. pp.* 1290–1294, *Oct.*, 1933.—The available published data suggest the generalisation that, in the organo-metallic derivatives of the elements from platinum to lead inclusive, stability of the acetylacetonates (and similar compounds) is related to polymerisation of the corresponding organo-metallic halides in benzene solution. Further experimental results support this view. Trimethylplatinum iodide is polymerised in boiling benzene, and methylmercury iodide is unimolecular in freezing benzene, as are triethyl-lead chloride at room-temperature (Barger's capillary method) and triethyl-lead bromide in freezing benzene. These observations are correlated by a consideration of the valencies and of the effective coordination numbers of the metals in question. Compounds with diketones have been made only in those cases where the effective coordination number is greater than the valency functioning, and only in such cases are the organo-metallic halides associated. The ready solubility of methylmercury iodide in organic solvents and its volatility at room-temperature suggest that the attractive forces between the constitutent atoms are completely or almost completely satisfied within the molecule, and this is confirmed by the observation that it is unimolecular in benzene. Volatility and solubility in organic solvents are characteristic of compounds in the molecules of which both the ordinary valencies and the coordination capacities of the constituent atoms are internally satisfied, and chelation is only one way in which this may be brought about; chelation is, indeed, possible only when the number of the ordinary covalencies functioning in the non-chelated enolic form is less than the potential coordination number. T. H. P.

13. Electronic Structure of Hexafluorides. T. G. Pearson and P. L. Robinson. *Chem. Soc., J. pp.* 1427–1429, *Nov.*, 1933.—The density and the surface tension of SF_6 have been measured over a range of temperature, and the parachor calculated therefrom indicates that the octet valency rule is maintained in this compound, two fluorine atoms being attached to the sulphur atom by covalent linkages and the remaining four by semipolar singlet links. The parachors of SeF_6 and TeF_6, calculated from their respective liquid densities and boiling points, reveal a structure identical with that found experimentally for SF_6.

AUTHORS.

14. Determination of the Valency Angles of the Oxygen and Sulphur Atoms and the Methylene and Sulphoxy Groups, from Electric Dipole Moments. G. C. Hampson, R. H. Farmer and L. E. Sutton. *Roy. Soc., Proc.* **143.** ***pp.*** **147–168,** ***Dec.*** **4, 1933.**—From the electric dipole moments of diphenyl methane, diphenyl ether, diphenyl sulphide and their derivatives, the angles between the axes of the phenyl groups in these compounds have been found to be 115° ± 5°, 142° ± 8°, and 118° ± 8° respectively. From data for anisoles and phenols, the angles in these have been estimated as 150° and 137° and the moments of the O–CH$_3$ and O–H links as 2·33 and 2·37 respectively. Application of these moments to dimethyl ether and water give angles in these latter compounds of 147° and 134°. Moments of diphenyl sulphoxide and its derivatives give the angles between each pair of valencies to be about 115°, and the moment of the S → O link to be 2·63. The significance of these results is discussed. AUTHORS.

15. Polar Structure of Molecules and the Nature of Secondary Valency Forces. G. Briegleb. *Zeits. f. phys. Chem.* **23.** *Abt.B.* **1–2.** *pp.* **105–130,** *Oct.*, **1933.**—Theoretical. The possibility of a physical interpretation of residual affinities is considered; a scheme is put forward showing the connection between residual affinities and the van der Waals forces. Both normal and associated compounds are considered. Reviews are given of the reciprocal action of molecules in the gaseous state from the standpoint of equations of state, and the theoretical calculation of virial coefficients and their dependence on temperature. W. R. A.

16. Relations between Stereochemistry and Physics. P. Debye. *Chem. Soc., J. pp.* 1366–1371, *Oct.*, 1933. *Faraday Lecture.*—The subjects dealt with include: polarity of molecules; connection between polar character and chemical structure; effect of temperature on dielectric constant; connection of dipole moment with the spatial structure of molecules; determination of the structure and dimensions of molecules by X-ray and kathode ray interference methods, etc. T. H. P.

17. Apparent Atomic Volumes and Coordination Centres of Insoluble Internal Complexes. G. Gutzeit. *Arch. des Sciences,* **15.** *pp.* **409–417,** *Sept.–Oct.*, **1933.**—A simple relationship between the atomic volume of the kation and the centres of coordination of the organic molecules is shown to be inapplicable to organic monosubstitution compounds. F. J. B.

18. Atomic Weight of Sodium. Part II. C. R. Johnson. *J. Phys. Chem.* **37.** *pp.* **923–933,** *Oct.*, **1933.**—A continuation of work previously reported [see Abstract 4793 (1932)]. Titration analyses with highly purified reagents and materials, and eliminating any constant error, give the value 0·541817 ± 0·0000010 for the ratio NaCl : Ag, from which, taking Cl = 35·457 and Ag = 107·880 the atomic weight of sodium is 22·994. Gravimetric analyses give the value 0·40779 ± 0·0000026 for the NaCl : AgCl ratio, whence Na = 22·994. N. M. B.

19. Molecular Weights of Dissolved Substances. A. W. Pound and J. R. Pound. *J. Phys. Chem.* **37.** *pp.* **969–972** *Oct.*, **1933.**—Using the solvents benzene, bromoform, phenol, acetic acid, and paraldehyde the molecular weights were found by the depression of freezing point method for the following substances, molecular association being indicated by M:—phenylacetaldehyde polymer M$_3$, paraldehyde M$_3$, anisaldehyde

M, cinnamaldehyde M, benzophenone M, phthalic anhydride M, cinnamic acid M or M_2, phenylacetic acid M or M_2, benzoic acid M or M_2, rhombic and monoclinic sulphur M_8. In certain cases the degree of association varied with the solvent and with the concentration. N. M. B.

20. Nuclear Distances of Mercury Halides (HgI_2, $HgBr_2$, $HgCl_2$). H. Braune and S. Knoke. *Zeits. f. phys. Chem.* 23. *Abt.B.* 1–2. *pp.* 163–170, *Oct.*, 1933.—The nuclear distances of three mercury halides are determined by the electron-diffraction method. The moments of inertia can be calculated from these distances and, with the aid of the previously determined dissociation equilibria, the unknown frequencies of the "bending" vibrations (*Knickschwingungen*) can be calculated.

J. E. K.

21. Atoms and Molecules. F. Hund. *Die Physik*, 1. 4. *pp.* 163–178, 1933.—The development of quantum-mechanical theories of atomic and molecular structure is described and the literature on this branch of physics is very comprehensively surveyed, well over 100 references being made to original papers. J. E. K.

See also Abstracts 82, 160, 192, 207, 234, 241, 242, 282, 306, 347, 349, 350, 351, 353, 371, 372.

COLLOIDS.

22. Dialysis in the Study of Colloids. Part I. Colloidal Ferric Hydroxide. B. N. Desai and S. K. Borkar. *Faraday Soc., Trans.* 29. *pp.* 1269–1285, *Dec.*, 1933.—The course of dialysis of a ferric hydroxide sol is followed by observation of several properties which are then compared. Cataphoretic velocity increases to a maximum and thereafter falls with further time of dialysis. Stability, measured by flocculation values with KCl, decreases from the start. In sols of different initial cataphoretic velocity, coagulation sets in at identical value. It is concluded that change of charge cannot be followed by observations of stability. Viscosity measurements compared with cataphoretic velocities do not agree with the v. Smoluchowski electro-viscous correction.

A. S. C. L.

23. Double Layer of Silver Iodide Sol. E. J. W. Verwey. *K. Akad. Amsterdam, Proc.* 36. 2. *pp.* 225–233, 1933.—Adsorption of $AgNO_3$ and of KI in undialysed AgI sols has been measured. From the results it appears that "ageing" proceeds rapidly but without particle growth and that there is also a slow ageing consisting of particle growth. The rapid decrease in amount adsorbed suggests that adsorption occurs at active corners, edges and sides of micro-crystals. A. S. C. L.

24. Influence of Motion upon the Electrical Conductivity of Hydrosols. W. S. Urbański. *Acta Physica Polonica*, 2. 2. *pp.* 181–192, 1933. *German Abstract.*—Some colloids, such as (V_2O_5) hydrosol, exhibit optical anisotropy when in motion, and a contingent electrical anisotropy has now been established. The measurements were made by a bridge method of which comprehensive details are given. Movement of the V_2O_5 sol oblique to the electrical lines of force causes an increase of electrical resistance, which grows with the velocity of the stream towards a limiting value. Experiments with electrodes widely apart indicates that a change of conductivity occurs in the body of the liquid. The phenomena are more complicated when the V_2O_5 sol has aged.

H. H. Ho.

25. Electrophoretic Mobilities and the Isoelectric Point of Protein-Coated Particles. O. Halpern. *J. Chem. Phys.* 1. *pp.* 882–884, *Dec.*, 1933.—It is a fact known by experiment that quartz or glass particles of microscopic size suspended in a liquid and coated with a superficial layer of protein exhibit in almost every instance the same mobility in response to the application of an electric field. This indicates that their electrophoretic potential is independent of the size and shape of the particles. Furthermore, the isoelectric point of these particles coincides with the isoelectric point of the proteinic ions in the solution. Some very general thermodynamic arguments are given in this paper indicating that a similar behaviour should be expected as a consequence of simple model properties. AUTHOR.

26. Optics of White Sols. Part II. T. Caspersson. *Kolloid Zeits.* 65. *pp.* 162–170, *Nov.*, 1933.—In continuation of previous work [see Abstract 4919 (1932)], the radiation of a single particle is derived from Mie's theory for different conditions of diameter, refractive index, wave-length of the incident light and variations of direction. Tables and curves of results are included. The appearance of the radiation diagram which gives the distribution in space is treated for different particle diameters, and possible means for the determination of particle size are indicated. The combined effect of a large number of particles, as in a colloidal solution, is calculated, and an expression is derived for the course of the nephelometric curve. Finally, the validity limits of the Beer law are discussed, and a common source of error in the usual measuring methods is indicated whose quantitative computation is rendered possible by the results of this investigation. H. H. Ho.

27. Bound Water in Disperse Systems. A. Dumanski. *Kolloid Zeits.* 65. *pp.* 178–184, *Nov.*, 1933.—The principles of the methods available for this determination are discussed. The procedure suggested is as follows :—To the system (gel or powdered substance) to be investigated —either dry or containing a certain quantity of water—is added a sugar solution of definite concentration. The mixture is thoroughly shaken, left for 15–30 minutes, and filtered. The concentration of sugar in the filtrate is determined either refractometrically or polarimetrically. Two concentrations are found : (1) that based on the assumption that the sugar is dissolved in the whole of the water, and (2) that found in the filtered solution. If the difference between these two is known, the amounts of the free and combined water may be calculated. Since the colloidal solution may contain a part soluble in water, the concentration of the soluble substances must be found separately and a corresponding correction made. The formulæ necessary for the calculations are given and results are given of determinations of the bound water in sand, powdered barium sulphate, talc powder and powdered alumina. T. H. P.

28. Odometer Observations as a Means for the Investigation of Gel Structure. K. v. Terzaghi. *Kolloid Zeits.* 65. *pp.* 129–148, *Nov.*, 1933.—The framework of a gel in equilibrium consists of solid elements at whose points of contact, pressure and shearing forces may be transmitted, otherwise the gel has the properties of a liquid. When the framework is enlarged to macroscopic dimensions, it is possible to derive its structure model ; and in this connection odometer experiments afford the relationships between pressure and volume content (the pore

V. 19

number). Hitherto these data have only been determined for clays and gelatin. Similar relations have now been found for coarse disperse systems, and information is afforded respecting the permeability and the presence or absence of a flocculent or honeycomb structure. The shrinking and swelling of gels are investigated, and the differences between the gels and the structure models are discussed and explained by a boundary layer hypothesis. Thermal changes are also considered. H. H. Ho.

29. Importance of the Gas Phase in Emulsification. F. Rogowski and K. Söllner. *Zeits. f. phys. Chem.* 166. *Abt.A.* 5–6. *pp.* 428–432, *Oct.*, 1933.—The passage of ultrasonic waves through liquid mixtures results in emulsification. Experiments are described which show that this effect is either absent or only feebly observable, when the liquids are entirely gas-free. The character of the gas and the nature of the liquid do not appear to be main factors; and emulsification by methods other than ultrasonic, is subject to the same rule. Emulsification thus appears to be a phenomenon of three phases, one of which must be gaseous. J. P. A.

30. Phase Volume Theory and the Homogenisation of Concentrated Emulsions. J. B. Parke. *Chem. Soc., J. pp.* 1458–1459, *Nov.*, 1933.—Attempts to homogenise an emulsion containing more than 74 % by volume of oil (the disperse phase) resulted in the production of a new emulsion containing approximately the volume of oil required for the globules to be in closest packing provided that they are of uniform diameter. Microscopic examination of the new emulsion produced by homogenisation revealed that the globules were small and of almost uniform diameter. It was found very difficult to increase the oil content of such an emulsion. AUTHOR.

31. Size and Charge of Cloud Particles. N. Fuchs and I. Petrianow. *Kolloid Zeits.* 65. *pp.* 171–174, *Nov.*, 1933.—A photographic method is described for measuring the size, charge, and concentration of the droplets in a cloud in cases where the radius of the drops is above $0 \cdot 3\,\mu$. The method is applied to the determination of (1) the distribution of the drops of a condensed or dispersed oil cloud according to their size, and (2) the charges in a cloud charged by ultra-violet rays in relation to the sizes of the droplets. T. H. P.

32. Conductivity Measurements of Thorium and other Jelly-forming Systems. S. Prakash. *J. Phys. Chem.* 37. *pp.* 907–916, *Oct.*, 1933.—The electrical conductivities of jelly-forming systems of thorium arsenate, phosphate, and molybdate, ferric arsenate, and aluminium hydroxide have been investigated. When the equilibrium between the jelly-forming components has become established, the conductivity becomes constant and remains so during the jelly-formation and after the setting. With thorium arsenate, slight decrease in the conductivity occurs as opalescence develops. The conductivity always increases if the jellies are allowed to age for a few days. The conductivities found for thorium arsenate and phosphate jellies exceed the additive values for their components, as the use of dihydrogen salts in their preparation gave rise to free nitric acid. With thorium molybdate jelly, prepared from a normal salt, and also with aluminium hydroxide, the conductivity is less than that of the components. The relation between the conductivity and

temperature is linear over a wide range; for thorium molybdate and aluminium hydroxide jellies, the temperature coefficient is about 2 % of the value at 35° C., whereas in the other cases it is from 1 to 1·5 %.
T. H. P.

33. Electrical Conductivity of Gelatin. Suzanne Veil. *Comptes Rendus*, 197. *pp.* 1044–1046, *Nov.* 6, 1933.—With one electrode consisting of a circular ring of metal foil in contact with the gelatin and the other of a wire touching it at the centre of this ring, the current time curve shows a sharp rise to a maximum in the first half hour, followed by a sharp drop in the next 1·5 hours, and then a slow decline to nil. The current voltage curve shows that Ohm's law is obeyed at first, but that thereafter there is a steady decrease in the current voltage ratio, resulting in a constant "saturation" current. Agar agar behaves similarly though less clearly so.
C. A. S.

See also Abstracts 48, 148, 368.

CRYSTAL STRUCTURE AND PROPERTIES.

34. Structure and Gas-Content of Sputtered Nickel. W. Büssem and F. Gross. *Zeits. f. Physik*, 86. 1–2. *pp.* 135–136, *Oct.* 17, 1933.—Nickel sheets, obtained by kathodic sputtering in hydrogen or in a mixture of neon and helium are found to be either hexagonal ($c/a = 1\cdot603$) or cubic, according to the conditions of sputtering. The hexagonal form is converted by heating into the cubic form, with evolution of hydrogen. When sputtering takes place in nitrogen, the nickel is found to be tetragonal ($c/a = 1\cdot295$), hexagonal ($c/a = 1\cdot593$) or cubic, according to the conditions of sputtering. The tetragonal form is converted by heating to the hexagonal form, and by further heating to the cubic form, a mixture of hydrogen and nitrogen being evolved.
J. T.

35. Submicroscopic Differences between Cast and Recrystallised Metals. U. Dehlinger. *Phys. Zeits.* 34. *pp.* 836–838, *Nov.* 15, 1933.—Differences in behaviour between cast and recrystallised metals are discussed. It is suggested that they may be explained by assuming that the grains of recrystallised metal have a mosaic structure more marked than that of grains of cast metal. Further experiment is necessary to test this. Extrapolation from experimental curves suggests that for metals which are 100 % pure the differences in question will disappear.
J. T.

36. Broadening of Debye-Scherrer Lines on Cold-Working. S. Konobejewski and J. Selisski. *Phys. Zeits. d. Sowjetunion* 4. 3. *pp.* 459–480, 1933. *In German.*—The broadening of the Debye-Scherrer lines of cold-worked metals and the disappearance of this effect on heating are investigated. The metals examined are Cu, Fe, Al, Zn, Mg and "Electron" alloy, special reference being paid to the last two. In the case of Mg it is found that, for temperatures below the recrystallisation temperature there is an approximate exponential relationship between the time of heating and the breadth of the lines. The effects observed in the case of "Electron" metal are considered to be due to diffusion of Al- and Zn-atoms within the deformed lattice. This diffusion can lead to the formation of a new phase.
J. T.

37. Structure of Silver Amalgam. A. Weryha. *Acta Physica Polonica*, 2. 2. *pp.* 161–179, 1933. *German Abstract. Zeits. f. Krist.* 86. *pp.* 335–339, *Nov.*, 1933.—The structure of Ag_3Hg_4 is investigated by the powder method. It is cubic, the unit cell containing four molecules, and the length of the edge being 10·09 Å. The space group is O_h^9. The Ag atoms are in the twelve V_d positions and the Hg atoms are in the sixteen C_{3v} positions, the parameter value in the latter case being 23/120. The same structure is found for Ag_3Hg_4 prepared by dropping mercury in a solution of $AgNO_3$ as for the amalgam formed when a silver wire is dipped in mercury. A tabular method of calculation for the case of Ag_3Hg_4 is given which shortens the work by about 80–85 %. J. T.

38. Crystal Structure and Ferromagnetism of Mn-Al-Cu Alloys. O. Heusler. *Zeits. f. Metallkunde*, 25. *pp.* 274–277 ; *Disc.*, *pp.* 277–278, *Nov.*, 1933.—Demonstration of a three-fold superstructure in the β-phase, as established by X-ray and conductivity observations, together with the results for temperature-magnetisation experiments for various atomic concentrations. F. I. G. R.

39. X-Ray Studies of Fatty Acids. F. B. Slagle and E. Ott. *Am. Chem. Soc., J.* 55. *pp.* 4396–4418, *Nov.*, 1933.—Re-measurement of long spacings of the normal saturated fatty acids using specimens of known high degree of purity. It is assumed that previous workers have examined less pure specimens and these results are claimed to be more accurate. Differences are recorded due to previous physical history of the specimens. An additional spacing, not previously observed, is recorded for myristic acid. Single spacings were obtained from a number of two- or more-component mixtures indicating solid solution. A. S. C. L.

40. Fine Structure of the Structurally-Isomeric Hydrocarbons Quaterphenyl and Triphenylbenzene. E. Hertel and G. H. Römer. *Zeits. f. phys. Chem.* 23. *Abt.B.* 3–4. *pp.* 226–234, *Nov.*, 1933.—Quaterphenyl forms monoclinic crystals with $J_a=8·14$, $J_b=5·64$, $J_c=18·4$ Å. $\beta=97°$. The space group is C^5_{2h} and the unit cell contains two molecules of symmetry C_i. Analogous lattice structures are shown by di- and terphenyl. Symm.-triphenylbenzene forms rhombic-bipyramidal crystals, $J_a=11·12$, $J_b=19·8$, $J_c=7·6$ Å.U. The space group is V^{16}_h and there are four molecules of symmetry C_s in the unit cell. The mirror plane in the molecule is perpendicular to the ring-plane, and parallel to (001) the molecules form a pseudo-hexagonal molecule-lattice. T. H. P.

41. Theory of Anisotropic Liquids. Part XVIII. C. W. Oseen. *Arkiv f. Mat., Astron., och Fysik, Stockholm*, 23 *A.* 24. *pp.* 1–5, 1933. *In German.*—Analytical and geometrical treatment of the cholesteric-nematic substances. These compounds show either " focal-conic " structure or a layer form. Energy equations are developed to account for these effects. [See Abstract 5129 (1933) and following Abstract.] F. I. G. R.

42. Theory of Anisotropic Liquids. Part XIX. C. W. Oseen. *Arkiv f. Mat., Astron., och Fysik, Stockholm*, 23 *A.* 25. *pp.* 1–27, 1933. *In German.*—An elaboration of previous work [see preceding Abstract]. In the present paper, the influence of external forces is discussed. These tend to bring about molecular orientation. The stability of three different thermodynamic states is considered analytically. F. I. G. R.

43. Apparatus for the Growth of Metal Single Crystals. M. F. Hasler. *Rev. Sci. Instruments*, 4. *pp.* 656–660, *Dec.*, 1933.—A simple crystal growing apparatus is described which allows the production of very uniform single crystalline rods of low melting point metals. The crystals

may be produced in any desired gas atmosphere or in a vacuum. Any orientation of crystal to rod may be obtained by a simple seeding procedure.
AUTHOR.

See also Abstracts 45, 187, 236, 324, 358, 363.

DENSITY.

44. Critical Density of Nitrogen Peroxide. K. Bennewitz and J. J. Windisch. *Zeits. f. phys. Chem.* 166. *Abt.A.* 5–6. *pp.* 401–415, *Oct.*, 1933.—A new method suitable for the investigation of densities of liquids when under considerable pressure, is described. The substance—in this case N_2O_4—is enclosed in a quartz-glass capillary, which also contains a small float of glass, a little too heavy to rise. Inside the float is fixed a small permanent magnet. When a current i is switched on in a solenoid coaxial with the tube, the float is pulled upwards with a force proportional to i^2: the value of i at which the float just moves from the bottom may thus be arranged to measure the variation in density of the liquid. The density-temperature curve for N_2O_4 under these conditions is obtained from 17·60° to 158·20° C. (the critical temperature), and from observations of the height of the meniscus in the tube, the density of the saturated vapour is also obtained. By extrapolation the critical density is found to be 0·570.
J. P. A.

45. Densities of Organic Crystals. A. Mukherjee. *Indian Journ. Phys.* 8. *pp.* 147–149, *Oct.* 7, 1933.—Determinations of the densities of crystals of 24 organic substances by the method of Krishnan, Guha and Banerjee [see Abstract 2616 (1933)], by which the density of the most dense fragments of apparently perfect crystals is determined by flotation. The determined densities are in better agreement with the corresponding densities calculated from X-ray data than ordinarily tabulated values.
P. H. B.

See also Abstract 71.

DIFFUSION AND OSMOSIS.

46. Freezing Points and Osmotic Pressures of Lactose Solutions. E. O. Whittier. *J. Phys. Chem.* 37. *pp.* 847–849, *Oct.*, 1933.—Freezing points of lactose solutions were determined by the Beckmann method, and depressions, when plotted against concentrations together with available values for sucrose, give a linear graph. The calculated osmotic pressures agree within 1 % with those for sucrose, and since, as established by freezing point determinations on a solution containing both sugars, the osmotic pressures of the two sugars are additive, it is concluded that one may be substituted for the other in solutions without appreciable influence on osmotic effects.
N. M. B.

ELASTICITY AND PLASTICITY.

47. Diffraction of Plane Elastic Waves on an Elliptic Boundary. V. Kupradze. *Accad. Lincei, Atti,* 18. *pp.* 130–135, *Aug.*, 1933.—The complete solution by means of Mathieu functions is given of the problem of the reflection and diffraction of a plane wave on an elliptic boundary in a homogeneous elastic medium.
A. J. McC.

48. Enhanced Tenacity of Thin Fibres, the Joffé Effect and Related Phenomena. E. Orowan. *Zeits. f. Physik,* 86. 3–4, *pp.* 195–213, *Oct.* 31, 1933.—The phenomenon of the enhanced tenacity of

materials when drawn into the form of thin fibres, the influence of grain-size and the surrounding medium upon the phenomenon are interpreted by the aid of Griffith's theory of fracture. The interpretation supports Joffé's explanation of the Joffé effect; Smekal's interpretation of the effect is not supported by the results. [See also Abstract 2740 (1933).]
J. S. G. T.

49. Bending of Thin Plates under Normal Pressures. B. Sen. *Phil. Mag.* 16. *pp.* 975–979, *Nov.*, 1933.—A simple mathematical method is used to show that the solution of the problem of the thin plate bent by transverse loads is unique in character when the edge is clamped or supported, and that when the edge is free the solution is indeterminate in the sense that two values of displacements satisfying the equation of equilibrium and the boundary conditions may differ by an expression which is a linear function of the coordinates. J. P. A.

50. Temperature Coefficient of the Elastic Moduli of Spring Materials Used in Instrument Design. W. G. Brombacher. *Rev. Sci. Instruments,* 4. *pp.* 688–692, *Dec.*, 1933.—A summary is presented of the values obtained by various observers of the temperature coefficients of the modulus of rigidity and Young's modulus of elasticity for the metals and alloys of possible usefulness in the construction of the elastic members of instruments. The composition of each material is given and also the condition of heat treatment or cold work. Much of the data is the result of recent work at the Bureau of Standards.
AUTHOR.

51. Hardening of Plastic Materials. F. K. G. Odqvist. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 360–363, *Oct.*, 1933.—The tendency of some plastic solids to become less plastic as time proceeds, may be represented as a time change of the critical shear stress *k*, which gives the flow limit. On the assumption that the material is isotropic with regard to *k*, it is possible to arrive at a satisfactory theory of yielding under tension or torsion. Examples are given. J. P. A.

52. Extensional Vibrations of Rods and Tubes. Parts I and II. E. Giebe and E. Blechschmidt. *Ann. d. Physik,* 18. 4. *pp.* 417–456, *Oct., and* 18. 5. *pp.* 457–485, *Nov.*, 1933. *From the Reichsanstalt.*—The Rayleigh formula giving the frequencies of the overtones in a vibrating bar which is not very thin, proves to be inadequate. Experiments performed on tubes, circular cylinders and rectangular rods of nickel and of nickel alloys provide data for this conclusion. Vibrations over a wide range of frequencies are generated by making use of the magnetostrictive properties of these materials. A new theory is offered, based on the idea of a coupling between the directly generated axial vibrations, and the secondary transverse vibrations. Frequencies of overtones calculated from this theory agree more satisfactorily with experimental results. Some confirmatory experiments are also performed on a tube of piezoelectric quartz. In Part II the theory for rods of rectangular section is developed. The same view of the coupling of transverse and longitudinal oscillations is adopted, and the results are tested upon specimens of nickel and nickel alloys, whose magnetostrictive properties facilitate the generation and measurement of oscillations. The theory is confirmed over a wide range of frequencies, extending to the region in which resonance occurs between the longitudinal and axial components. J. P. A.

53. Effect of Small Cavities and Cracks in a Cylinder Twisted by Torsional and Shearing Stresses. B. B. Sen. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 374–379, *Oct.,* 1933. *In English.*—The author refers to former work on this subject by Love, Southwell and Gough, and Larmor. In the paper the stresses in a circular cylinder twisted by terminal couples have been calculated, the shaft having a small spherical or spheroidal cavity on the axis or a linear flaw extending from end to end along the axis. In addition the solution of the problem of finding the effect of a cylindrical flaw with elliptic section when the body has a plane distribution of shear at a distance is given. It is shown that (1) for the small spherical cavity on the axis if rupture commences it will be at a point on the equatorial section of the cavity and will follow a spiral path; (2) for the cavity in the form of a prolate or oblate spheroid, whose axis of revolution coincides with the axis of the cylinder, the shearing stress is increased by the cavity; (3) for a coaxial cylindrical flaw with elliptic section the tangential stress is increased, and when the limiting conditions occur, the shearing stress at the ends of the crack becomes very large and tends to produce rupture. R. S. R.

GRAVITATION.

54. Finite Expressions for Normal Gravity. C. Somigliana. *Bull. géodésique,* 38. *pp.* 178–187, *April–May–June,* 1933.—This paper is a critical view of various equations that have been proposed to evaluate *g*. W. A. R.

55. Isostatic Reduction according to the Airy Hypothesis. F. A. V. Meinesz. *Bull. géodésique,* 38. *pp.* 188–197, *April–May–June,* 1933.—In order to avoid the publication of a large body of data this note suggests a method of computation which requires the publication of only one quantity in addition to the mean elevation of the area of compensation. [See Abstract 1547 (1932).] W. A. R.

56. Stresses in Gravitating Solid with Horizontal Cylindrical Inclusion. G. Nishimura, T. Takayama and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 11. *pp.* 454–487, *Sept.,* 1933. *In English.*—The investigation is continued [see Abstract 4353 (1933)] of the stresses in the vicinity of a horizontal cylindrical mass included in a gravitating semi-infinite medium which is in a state of plane stress or plane strain. In the case now studied, the medium is in a state of plane stress, and the distribution and magnitude of stresses differ accordingly. The conclusions are summarised and illustrated by numerous diagrams, as in the previous papers. E. L. J.

HYDRODYNAMICS AND AERODYNAMICS.

57. Burgers Phase Field and Questions on Turbulence Statistics. W. Tollmien. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 331–347, *Oct.,* 1933.—The author refers first to interesting facts regarding turbulence statistics obtained by Burgers and v. Kármán, and the difficulties which occur in the statistical development are discussed in detail. He then considers the case of two-dimensional turbulent flow of a fluid between the straight parallel sides of a tube, a frictional zone at the boundary being excluded. The Burgers phase field is constructed for this flow of an ideal fluid and the proof of the Liouville theorem for the field is given. The energy conditions and the forces at the boundaries are next found. It is considered that the results obtained will form a contribution to the basic question of what influence the artificially introduced point grating has on the physical results. The difficulties of the procedure used are discussed and the possible use of the method when extended to a three-dimensional flow of the fluid. R. S. R.

58. Motions of a Mass of Viscous, Isotropic and Heterogeneous Fluid. A. Charrueau. *Comptes Rendus*, 197. *pp.* 1091–1093, *Nov.* 13, 1933.—A mass of viscous, isotropic heterogeneous fluid subjected to certain definite motions and bounded by a surface, S, which varies with time but throughout retains the form of a surface of revolution about a fixed axis is placed in a medium of normal, uniform pressure. It is shown that at all subsequent times, if the superficial layer of fluid does not rotate as a whole, the surfaces of revolution given by ω=constant are normal to S. The result has application to the internal motion of stars. J. S. G. T.

59. Flow of Fluids in Conduits. L. D. Williams. *Indust. & Engin. Chem.* 25. *pp.* 1316–1319, *Dec.*, 1933.—Standard methods for calculating pressure drops in various types of conduits are assembled, simplified, and explained so that problems can be solved more rapidly and with less chance of error than has been possible hitherto. The principal means employed to accomplish this are: (1) Common units are used throughout; (2) the significance and limitation of each factor are reviewed; (3) a little known procedure for gases with large pressure drops is adapted for general use; and (4) treatment of non-circular conduits is simplified. AUTHOR.

KINETIC THEORY OF MATTER.

60. Action of Crookes Radiometer in the H.F. Discharge. T. V. Ionescu. *Comptes Rendus*, 197. *pp.* 1103–1104, *Nov.* 13, 1933.—The mode of action of an oscillator may be modified by introducing between the plates of the condenser of the oscillating circuit a tube in which the pressure is between 10^{-3} and 10^{-1} mm. Hg. There are two modes of working: (1) the oscillator furnishes little energy even when strongly heated if the heating is gradual; (2) for the same heating the oscillator gives a much greater amount of energy; this mode may be produced by taking away one of the plates for a few moments. The author has studied the energy consumed in the midst of the ionised gas by means of a Crookes radiometer. It is as sensitive to electric as to luminous waves. The oscillator is slowly heated, the discharge does not pass in the radiometer; the mill turns in the usual direction, the unblackened faces forwards. The velocity of rotation increases with the current in the oscillator. When the discharge passes in the radiometer the mill continues its rotation in the same direction but much more slowly. In explanation of these phenomena: the mill is heated by the radiations of the ionised gas that the blackened faces absorb, by the currents induced in these faces and by the electronic bombardment striking the two faces. It is cooled due to the conductivity of the gas and also by loss of heat from the blackened faces by radiation. In the second mode, for pressures less than $1 \cdot 5 \times 10^{-2}$ mm. Hg the heat lost by radiation is very great for the blackened faces and the radiometer turns in the inverse direction. J. J. S.

See also Abstracts 179, 261, 262, 372.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 377.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

61. Testing of Statistical Hypotheses in Relation to Probabilities. J. Neyman and E. S. Pearson. *Cambridge Phil. Soc., Proc.* 29. *pp.* 492–510, *Oct.* 30, 1933.—Considers now more fully the bearing of the earlier results [see Abstract 2202 (1933)] on the question of *a priori* probability; and in particular discusses which statements of value to the statistician can be made from an analysis of observed data which would not be modified by any change in the probabilities *a priori*. Full discussion, with problems worked out. A. D.

62. Theory of Probability. A. A. Bennett, *Electrical Engineering,* 52. *pp.* 752–757, *Nov.,* 1933.—The theory of probability has found many applications, some of a practical nature, others less elementary, such as in the development of statistical theories of matter. There is a mathematical theory of probability, the rules of operation of which are generally acceptable and lead to results of increasing scientific and economic significance; however, the theory is still considered to rest upon an unsatisfactory philosophical basis. This article presents a brief outline of the history of probability theory and more detailed discussions of present concepts. AUTHOR.

63. Graphic Statistics. A. F. Dufton. *Phys. Soc., Proc.* 46. *pp.* 47–49, *Disc.,* 50. *Jan.* 1, 1934.—The plotting of frequency-distributions is discussed. In comparing for different populations the frequency-distributions of a particular variate it is sometimes convenient to take one population as standard and to represent its distribution by a straight line. It is pointed out that the method of plotting individual points described by Hazen is incorrect. AUTHOR.

See also Abstracts 72, 114.

MECHANICS, CLASSICAL.

64. Wave Radiation Associated with Phenomena. Z. Pycha. *Accad. Lincei, Atti,* 18. *pp.* 123–129, *Aug.,* 1933.—Following on some results in the wave motion associated with phenomena [see Abstract 2780 (1933)], the author assumes a particular law connecting the wave propagation and the propagation of energy. By this means he associates a corpuscular motion with the wave propagation; he applies his results to a group of waves and gives an extension to the definition of group velocity. A. J. McC.

MECHANICS, QUANTUM.

65. Propagation of a Plane Wave Associated with the Movement of a Particle. P. Copel. *Comptes Rendus,* 197. *pp.* 976–978, *Oct.* 30, 1933.—The solution, corresponding to a plane wave, of the most general form of equation of wave propagation is written down and applied to various problems that occur in wave-mechanics. G. C. McV.

66. Negative Energy Levels in Dirac's Theory. Z. W. Chraplywyj. *Acta Physica Polonica,* 2. 2. *pp.* 193–204, 1933. *English Abstract.* —Schrödinger's method of " odd " and " even " operators for the removal of the difficulty of the existence of solutions of negative energy of the Dirac equation, is critically examined. It is rejected as unsatisfactory as it can be shown to destroy the invariant nature of the equation. A tentative modified form of the Dirac equation is put forward which has no negative energy solutions. G. C. McV.

67. Eigenpotential of an Electron in Wave-Mechanics. Z. Chraplywyj. *Acta Physica Polonica,* 2. 2. *pp.* 205–213, 1933. *German Abstract.*—The effect of introducing into the wave-equation of a free electron the electromagnetic potential created by its own motion is investigated. No results contrary to experiment are found. G. C. McV.

See also Abstracts 21, 64, 69, 139, 196, 198, 239, 353, 354.

RELATIVITY AND ETHER.

68. Motion of a Particle in a Centrally-Symmetrical Gravitational Field. G. Järnefelt. *Zeits. f. Astrophysik,* 7. *pp.* 326–328, *Nov.* 12, 1933.—The geodesics of certain fields found by Lemaître [see Abstract 2596 (1931)] are worked out in detail. G. C. McV.

69. Formulation of the Laws of Nature in Terms of Five Homogeneous Coordinates. Part II. W. Pauli. *Ann. d. Physik,* 18. 4. *pp.* 337–372, *Oct.,* 1933.—The theory already developed [see Abstract 5176 (1933)] of the projective geometry of a Riemannian four-dimensional space is further extended by the expression of the coefficients of the metric in the projective space in terms of four-rowed matrices. The transformations of these matrices are related to the rotations of the projective space. A new calculus of spinors is introduced whose fundamental axiom is that spinors transform covariantly with the matrices defining the metric. The wave-equation of Dirac can then be written down in terms of projective coordinates and can then be transformed to ordinary Riemannian coordinates and spinors in the four-space. The energy-momentum tensor and the charge and current vector are also deduced and represent the effects of the presence of matter in the field. The author points out that the ordinary equations of general relativity relating the curvature of space to the energy of electromagnetic forces and to the energy of matter can be derived but that whereas the curvature is naturally related to electromagnetic energy in this theory, the material energy is not, but has to be introduced by the *ad hoc* process of the addition of two invariants. He concludes that this is inevitable so long as the problem of the quantisation of the electromagnetic field remains unsolved. G. C. McV.

SOLUTION.

70. Rate of Solution of Solid into Liquid. S. Miyamoto. *Chem. Soc., Japan, Bull.* 8. *pp.* 316–326, *Oct.,* 1933. *In English.*—Assuming that only those molecules on the solid surface the components of the energy of vibration of which $\perp$ to the interface exceed a threshold value, ϵ_0, can enter the liquid phase, of which the proportion β actually does so, and similarly that only those molecules in the liquid phase of which the component of velocity $\perp$ to the interface exceeds u_0 can condense on the solid surface the rate of solution is

$$S\left(\beta N_0 e^{-N\epsilon_0/RT}/N - C\sqrt{RT/2\pi M}.\ e^{-Mu_0^2/2RT}\right)/v,$$

transformable into $KS(c_\infty - c)$, where S is the area of the boundary surface, v the volume of the liquid phase, N_0 the number of molecules per unit area of solid surface, N Avogadro's number, M the molecular weight of the dissolved substance, c the concentration of the dissolved substance in the liquid phase, c_∞ the saturation concentration, K a constant, and R, T have their usual meanings. The formula is applied to explain several experimental results. [See also Abstracts 896 (1933) and 255 (1934).] C. A. S.

71. Physical Properties of Mixtures of Organic Liquids. Violet C. G. Trew and Gertrude M. C. Watkins. *Faraday Soc., Trans.* 29. *pp.* 1310–1318, *Dec.,* 1933.—Density, refractive index, magnetic susceptibility, viscosity and other properties have been observed in mixtures of various aliphatic alcohols to test the mixture rule. In every case some deviations were found. These are attributed to coordination. A. S. C. L.

72. Derivation of Equations for Regular Solutions. J. H. Hildebrand and S. E. Wood. *J. Chem. Phys.* 1. *pp.* 817–822, *Dec.,* 1933. —The probability function of Menke has been used as a basis for a statistical treatment of the intermolecular potentials in solutions of symmetrical molecules for which the entropy of mixing is the same as for an ideal solution of the same composition. The resulting expressions enable calculations to be made of the departure of iodine solutions from the ideal solution laws which agree satisfactorily with the observed departures. AUTHORS.

See also Abstract 144.

SURFACE TENSION AND COHESION.

73. Structure of Surface Films. Part XX. Surface Potential Measurements on Nitriles. N. K. Adam and J. B. Harding. *Roy. Soc., Proc.* 143. *pp.* 104–111, *Dec.* 4, 1933.—Surface potential measurements on monomolecular films of long chain nitriles indicate a maximum value of μ, calculated from the simple Helmholtz equation, only about one-seventh of the dipole moment of the nitrile group as obtained by other methods. In the nitrile group there is no possibility of modification of the value of the dipole by internal rotation of the different parts of the polar groups, hence the effective " dielectric constant " of the surroundings of the film molecules is probably of the order 7. The transition between condensed and expanded films is unquestionably heterogeneous with the nitriles. [For Part XIX see Abstract 5182 (1933).] AUTHORS.

74. Oil Lenses on Water, and Monomolecular Expanded Films. I. Langmuir. *J. Chem. Phys.* 1. *pp.* 756–776, *Nov.,* 1933.—A nearly complete theory of all observed characteristics of expanded films, elaborated from the author's previous theory. Equations are developed for determining from static measurements of oil lenses on water the spreading coefficient $\gamma_1-\gamma_2-\gamma_{12}$, the linear tension at the periphery, and the interfacial tension. The effect of adding hydrophilic molecules to the interface is dealt with. Confined films thin enough to be unaffected by gravity (" duplex films ") are discussed in detail. Data given by Adam are used to support the theory. P. H. B.

75. Surface Tension of Film-Covered Liquids at Saturation. H. Brown. *Am. Chem. Soc., J.* 55. *pp.* 4521–4523, *Nov.,* 1933.—The equation $\sigma_{1\cdot3} = \sigma_{1\cdot2} + \sigma_{2\cdot3}$ for the surface tension, $\sigma_{1\cdot3}$, of a liquid covered by a film covers two cases : where the film is thick enough for its interior to have the structure of a bulk phase and where it is a monomolecular film and does not fulfil this condition. This difference is discussed and used to explain the formation of lenses of liquid existing in equilibrium with monomolecular films. A. S. C. L.

76. Electrokinetic Phenomena in Capillaries. H. Reichardt. *Zeits. f. phys. Chem.* 166. *Abt. A.* 5–6. *pp.* 433–452, *Oct.*, 1933.—The author's earlier work [see Abstract 3654 (1931)] is extended. Unusual ζ-potentials are to be expected at the boundary with small streaming speeds such as exist in capillaries. Saxeen's relation holds good for capillaries. Electrokinetic equations are put forward for capillaries in which the double layer forms an appreciable proportion of the total liquid volume. The outflow from such a capillary when submitted to a pressure-difference can only be reduced by the field due to the streaming potential. Equations for wide tubes are also given. It is confirmed that turbulence is not possible in the double layer. P. H. B.

77. Measurement of Surface Tension by Parallel Plate Method. N. Sata and K. Kurano. *Kolloid Zeits.* 65. *pp.* 191–195, *Nov.*, 1933.—The usual calculated formulæ for capillary elevation and the meniscus of a liquid between parallel plates apply only to infinitely wide plates. The observed meniscus height of water between narrow glass plates of 4 different compositions is given. The author concludes that the composition of the glass does not significantly affect the meniscus height. Observed capillary elevations of water, aniline, nitrobenzol, alcohol, chloroform and bromoform between glass plates of widths up to 13 mm. are given and compared with the corresponding calculated elevations for infinite plates. Observed meniscus heights of these liquids against single vertical glass plates of graded widths are also compared with corresponding calculated values for infinitely wide plates. P. H. B.

78. Measurement of Surface and Interfacial Tensions. J. C. Speakman. *Chem. Soc., J. pp.* 1449–1453, *Nov.*, 1933.—A modification of existing methods for measuring surface and interfacial tensions is described, consisting in observing the difference between the pressures required to force the menisci in two capillary tubes of different bores to the same arbitrarily selected level. The method is shown to have certain advantages over others. AUTHOR.

79. Capillary Ascent or Depression of Liquids in Cylindrical Tubes. Part II. Wide Tubes. A. W. Porter. *Faraday Soc., Trans.* 29. *pp.* 1307–1309, *Dec.*, 1933.—Table for meniscus shape for tubes of larger size than those already given [see Abstract 3952 (1933)] and for contact angles from 0 to 90°. A. S. C. L.

See also Abstracts 1, 13.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

80. Theory of "Protecting Pendulum." E. Rieckmann. *Phys. Zeits.* 34. *pp.* 841–842, *Nov.* 15, 1933.—Modern methods of control of the pendulum clock have resulted in great improvements. These make imperative the provision of some form of shelter from shocks due to earth tremors and vibration due to traffic, etc. This is realised by the "protecting pendulum," the construction of which is such that disturbances of the second order are without effect on the resulting clock. P. H. B.

VACUA, HIGH.

81. High-Vacuum Gauge. F. Yamasaki and Z. Yosida. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 400–404, *Oct.*, 1933. *In English.*—A McLeod gauge of the ordinary type is unsuitable for measuring pressures less than about 5×10^{-5} mm. of Hg. It is shown in this paper that the

range may be extended by closing the capillary limb by a thin mica membrane and mounting a mirror and optical lever system on the membrane. As the gas in the closed limb is compressed the diaphragm is distorted to an extent depending on the pressure, so that the spot of light can be made to measure the pressure. Plotting the log deflection against log pressure as measured by the gauge showed a straight line, and extrapolation suggested that the method might be used to pressures as low of 10^{-8} mm. of Hg.
G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

82. Viscosity Formula for Binary Mixtures. T. Ishikawa. *Chem. Soc. Japan, Bull.* 8. *pp.* 280–296, *Sept.*, 1933. *In English.*—In previous papers a formula was developed for the viscosity of binary mixtures in which the degree of association was taken into account. The work is continued and the formula applied to the published results of other observers on benzene and brombenzene, methyl and ethyl alcohol, methyl alcohol and water, ethyl alcohol and water, acetic acid and water, and to certain standard lubricating oils. F. J. B.

83. Theory of Liquid Viscosity. D. Silverman. *Faraday Soc., Trans.* 29. *pp.* 1285–1294, *Dec.*, 1933.—An evaluation and extension of Maxwell's equation, $\eta = Et$ where E is elasticity modulus and t time of relaxation, on the view that transitory aggregates exist. For these t will be the average life, which is small since it concerns stress between collisions. Values calculated are of the order of 10^{-13}. The mean energy of dissociation of the aggregates is calculated from known viscosities; and the effects of temperature and compression on viscosity of several substances are given, with good agreement, by the equations derived. A. S. C. L.

84. Wall Effect in Falling Ball Method for Viscosity. A. W. Francis. *Physics*, 4. *pp.* 403–406, *Nov.*, 1933.—The wall effect for balls falling in a vertical cylindrical tube in a viscous fluid has been studied and expressed as an empirical function of the ratio of radii of the ball and tube. This function agrees well with observations at least to a ratio of 0·83 as compared with 0·09, the limit of agreement of Ladenburg's formula. The wall effect is probably independent of the absolute radii of the ball and tube and only slightly dependent upon the absolute viscosity. The bottom effect is negligible. For liquids of high viscosity the revised formula is $\eta = 2gR^2(\rho_1 - \rho_2)(1 - R/r)^{2\cdot25}/9u$. AUTHOR.

85. Measurement of Viscosity by Uniform Coaxial Movement of a Sphere in a Cylinder. G. Duffing. *Zeits. f. angew. Math. u. Mechanik*, 13. *pp.* 366–373, *Oct.*, 1933.—The author considers a pure viscous flow where all forces of gravitation may be neglected and where only shear strain in the direction of the stream lines need be considered. The flow is considered to be so slow that turbulence does not occur. The reverse case is treated mathematically with the sphere at rest and the cylinder and fluid moving and the total resistance to flow determined. An apparatus was constructed on these principles in which the sphere is supported from one arm of a balance and its upward movement through the fluid balanced by a weight supported on the other arm. The fluid can be maintained at any desired temperature. Calibration is obtained by using a fluid of known coefficient of viscosity and the mathematical solution and the calibration results are applied to obtain values for any other fluid. R. S. R.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

86. Modification of Schilt Photometer for Measurement of Stellar Magnitudes from Photographs. A. L. Bennett. *Astrophys. J.* 78. *pp.* 305–312, *Dec.*, 1933.—An instrument built in the Yale University Observatory is described and illustrated. The photographic plate is mounted horizontally. The Weston photronic cell is used as the light-sensitive element, in conjunction with a galvanometer. The field of the plate being measured, the galvanometer scale and the two coordinate scales are brought into a single eyepiece. AUTHOR.

87. Photometry with the Schraffierkassette. W. H. Christie. *Mt. Wilson Observat. Contrib. No.* 476. *Astrophys. J.* 78. *pp.* 313–319, *Dec.*, 1933.—The new Schraffierkassette constructed in the Mt. Wilson Observatory is described in detail and the method of measuring and reducing the plates obtained with it is briefly outlined. AUTHOR.

COMETS AND METEORS.

88. Problem of Cometary Orbits. G. Tiercy. *Arch. des Sciences*, 15. *pp.* 385–408, *Sept.–Oct.*, 1933.—The author assumes, stating clearly the hypotheses involved, that the velocities of cometary bodies on arrival within the sun's gravitational sphere obey a general probability law. The determining factor is the assumed normal velocity; this is deduced from observed comets. The consequences of two forms of the general law are worked out. In both cases the results agree with observation, elliptic orbits being several hundred times more frequent than hyperbolic, and eccentricities exceeding 1·01 being highly improbable; the results apply to theoretically observable comets, defined as those whose perihelion is within 4 astronomical units, and all results are dependent on the normal velocity adopted. T. L. M.

89. Analysis of CO$^+$ Bands. R. Schmid and L. Gerö. *Zeits. f. Physik*, 86. 5–6. *pp.* 297–313, *Nov.* 10, 1933.—As the identity of the ground states of the comet-tail bands and of first negative carbon group was not fully proved by previous measurements, the (3, 0), (4, 0), (4, 1), (5, 1), (6, 2), (7, 2) bands of the $^2\Pi \rightarrow {}^2\Sigma$ System and (0, 0) band of the $^2\Sigma \rightarrow {}^2\Sigma$ system have been measured and analysed. Comparison of the combination differences of these and previously analysed bands shows the identity of the rotation end-states and also permits indubitable numeration of oscillation and rotation levels. F. S.

90. Zeeman Effect of Comet-Tail Bands. R. Schmid and L. Gerö. *Zeits. f. Physik*, 86. 5–6. *pp.* 314–320, *Nov.* 10, 1933.—The $^2\Pi - {}^2\Sigma$ bands (5, 0), (6, 0), (7, 0) and (8, 0) were excited in a magnetic field of 15,000 to 20,000 gauss and photographed in various orders of a 6·5 m. grating. All observed lines split into symmetrical doublets, but the theoretical interval is only given for small values of the rotation quantum. Although the (8, 0) band shows perturbation, no systematic differences from other unperturbed bands are found. F. S.

91. Meteor Shower of 1933, October 9. A. King. *Nature,* 132. *p.* 720, *Nov.* 4, 1933.—This shower completely surpassed expectations. In southern England the sky was overcast, but in northern England, Scotland, and Ireland, and in many places right across Europe a magnificent display was seen. The maximum seems to have been at about 8 p.m., and the duration was about 4 hours, which indicates that the thickness of the stream at the part traversed by the Earth was some 300,000 miles. The meteors were moving in the track of the comet Giacobini-Zinner, and this " storm " was a return of the display seen in 1926. M. A. E.

COSMOGONY.

92. Cause of the Expansion of the Universe. T. Takéuchi. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 431–432, *Nov.,* 1933. *In English.* —It is pointed out that the formation of the empty region postulated in Sen's theory of the start of the expansion of an Einstein universe [see Abstract 2822 (1933)] might be due to the annihilation of matter.
G. C. McV.

93. Explanation of the Velocities of Recession of the Nebulæ. A. Machiels. *Comptes Rendus,* 197. *pp.* 1025–1027, *Nov.* 6, 1933.—It is pointed out that the theory of the expansion of the universe put forward by H. D. Curtis in *Handbuch der Astrophysik. Das Sternsystem,* Berlin, 1933, which is based on the Charlier universe, is vitiated by an incorrect use of the formula for the Doppler effect employed. G. C. McV.

NEBULÆ.

94. Shape of Spiral Arms. E. Reichenbächer. *Zeits. f. Astrophysik,* 7. *pp.* 309–319, *Nov.* 12, 1933.—It is shown that the equation of the spiral arms of nebulæ can be found to be approximately an equiangular spiral, if it is assumed that the arms are not identical with the paths of the stars they contain and that they start spontaneously from the central mass of gas. A method is indicated for determining the value of the radius of curvature of space in the neighbourhood of a nebula by measurements of its spiral arms. G. C. McV.

95. Distribution of Extra-Galactic Nebulæ. E. Hubble. *Mt. Wilson Observat. Contrib. No.* 485. *Astrophys. J.* 79. *pp.* 8–76, *Jan.,* 1934.—The object of the investigation is to determine the distribution of extra-galactic nebulæ to a faint uniform limiting magnitude. The material consists of counts of about 44,000 nebulæ on 1283 plates with the 100-inch and 60-inch reflectors, distributed over the three-quarters of the sky north of −30° Dec. The counts are reduced to the standard conditions of excellent one-hour exposures at the zenith on Eastman 40 plates with the 100-inch reflector. In general no nebulæ are found along the Milky Way. The zone of avoidance, representing local obscuration, is irregular and follows the general pattern of the known obscuring clouds. It is bordered by partial obscuration, which fades away into the regions of normal distribution where the frequency-curve of log N_m closely approximates a Gaussian error-curve. Systematic variations in longitude are appreciable only in the lower latitudes, where obscuration appears to be conspicuously greater in the direction of the galactic centre than in the opposite direction. There is a definite variation with latitude, which from the poles to about $\beta=15°$ is represented by the cosecant formula log $N_m=C-0{\cdot}15 \operatorname{cosec} \beta$, indicating a total obscuration of 0·5 mag. from pole to pole with no appreciable difference between the two hemispheres. With allowance for the effect of the red shift, the rate of increase of log N with exposure time suggests uniform distribution in depth. The standard conditions represent a threshold of identification for nebulæ at about 20·0 pg m. Corrected for red shift, the number of nebulæ per square degree to magnitude m is $\log N_m = 0\cdot6m - 9\cdot12$, which leads to values for the density of matter in space of $\log \rho = -16\cdot4$ to $-16\cdot8$ in nebulæ per cubic parsec, or $-29\cdot8$ to $-29\cdot9$ gr/cc, depending upon the value adopted for the mean absolute magnitude of nebulæ. AUTHOR.

See also Abstract 93.

STARS.

96. Radial-Velocity Variations of V Ursæ Minoris, R Sagittæ, and V Vulpeculæ. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 481. *Astrophys. J.* 79. *pp.* 77–83, *Jan.*, 1934.—Radial velocities are given for V Ursæ Minoris, R Sagittæ, and V Vulpeculæ obtained at Mount Wilson, mostly with a dispersion of about 75 Å per millimetre at Hγ. Plots by means of periods obtained from recent studies of extensive photometric data, fail to reveal any regularity in the velocity variations. These results are perhaps explicable on the assumption that the form of the velocity-curve changes markedly in the intervals over which the respective observations extend. R Sagittæ to some extent, and V Vulpeculæ more definitely, undergo spectral changes and show the earliest type at maximum and the latest at minimum. The hydrogen-line absorption and the G band become progressively stronger from maximum to minimum light. In V Vulpeculæ the bands of titanium oxide appear near one of the minima. AUTHOR.

97. Radial-Velocity Variation of UU Cassiopeiæ. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 482. *Astrophys. J.* 79. *pp.* 84–88, *Jan.*, 1934.—Periods of from 4 to 17 days have been assigned by different observers to the light variation of UU Cassiopeiæ. The light-curves are in some cases, however, complicated by secondary maxima. Luizet classified this star as a Cepheid. Twenty-six spectrograms over an interval of five years show the spectral class to be B1. The star is therefore probably not a Cepheid. The radial velocity is variable. The radial velocities and the two best series of light observations can be harmonised with the relations for an eclipsing binary if one-half the 17-day period is used. The velocity-curve indicates circular motion with an orbital velocity of at least 161 km./sec. The total mass of the system must be at least thirty times that of the sun. The uncertainty in the light-curves is so large that it is impossible to derive the data which are normally furnished by a combination of photometric and spectroscopic elements. AUTHOR.

98. Approximate Spectroscopic Elements for AG Virginis, RW Coronæ Borealis, and AK Herculis. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 483. *Astrophys. J.* 79. *pp.* 89–94, *Jan.*, 1934.—Radial velocities of the three variables AG Virginis, RW Coronæ Borealis, and AK Herculis give curves consistent with an eclipse of the brighter by the fainter star at primary minimum. On the assumption that $m_1 = 2m_2$ and that the inclination (i) of the orbit planes is 90°, the total masses are 0·93, 0·46, and 0·56⊙; and the distances of the centres 2·10, 1·80, and $1\cdot36 \times 10^6$ km., respectively. These values are quite in keeping with those for other stars for which complete solutions are available. AUTHOR.

99. Spectroscopic Orbital Elements for the Eclipsing Variable CM Lacertæ. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 484. *Astrophys. J.* 79. *pp.* 95–97, *Jan.*, 1934.—Wachmann found CM Lacertæ to be an eclipsing variable with a period of $1^{d}60469$ and with maximum, principal minimum, and secondary minimum equal to 8·14, 9·17, and 8·54 mag., respectively. Eclipse lasts 0·2 day. He does not state, however, whether he found evidence of totality. The radial velocities from fourteen spectrograms obtained in 1932 are well distributed in phase and confirm Wachmann's conclusion of variability by eclipse with the period mentioned. The observations are represented by circular motion with a minimum orbital velocity of 117·5 km./sec. for the primary and 159± km./sec. for the secondary, the latter value being much less reliable than that for the primary. The distances of the two components from the centre of mass of the system are not less than 2,500,000 and 3,500,000 km. Their respective masses are at least two and one and one-half times the solar mass. The distance of the secondary and the two masses involve the uncertainties in the secondary's orbital speed. Data are not available for deriving the photometric elements, and hence a complete solution of the orbit, which depends upon a knowledge of both the spectroscopic and the photometric elements, cannot yet be given. AUTHOR.

100. Neon Absorption Lines in Stellar Spectra. D. H. Menzel and R. K. Marshall. *Nat. Acad. Sci., Proc.* 19. *pp.* 881–883, *Oct.*, 1933. —The great strength and general occurrence of the " forbidden " emission lines of Ne III and Ne IV in the spectra of nebulæ and novæ is suggestive of a high cosmic abundance for this supposedly rare gas. A search is therefore made for the presence of neon lines in normal stellar spectra. According to the ionisation theory as developed by Fowler and Milne, the lines of Ne I and Ne II should come to a maximum in the near spectral classes B8 and B0. It is found that the strong Ne I line at λ6402·24 Å is present as a very faint line in the spectrum of β Orionis (B8*p*). The existence of a number of lines of Ne II multiplets in the spectrum of 10 Lacertæ (O9) is definitely established; their intensities are similar to those of O II, and since Ne II and O II have ionisation potentials of the same order of magnitude it appears that neon and oxygen have approximately equal abundances. Thus two of the so-called " rare " gases, helium and neon have high abundances in the universe. J. E. K.

101. Spectral Changes of β Lyræ. Antonia C. Maury. *Harvard Coll. Obs., Ann.* 84. 8. *pp.* 207–255, 1933.—This historic variable is a binary system with a supergiant primary revolving round an emission star, which, though darker, is far more massive and nearly at rest. The opposed eclipses and intervening light maxima divide the period of 12·92 days into four nearly equal parts. A complete record is here given of the spectral variations shown on 307 Harvard plates taken in 1886 to 1901 and 1921 to 1931. Perturbations in the hydrogen and helium lines of the primary indicate rapid rotation. Other changes are mainly due to the changing positions of the two stars relative to each other and to the observer during each revolution ; and as the stars are nearly in contact and ellipsoidal in shape, the phenomena differ on their inner and outer limbs, and also on their broad faces and their tidal extremities. Both stars are of extreme tenuity and of large radius, four million and ten million km. respectively; and a difference in visibility of different lines during eclipse is held to be due to difference of level in deep, rarefied, and very transparent gaseous envelopes. In addition to the cyclical changes, there is an irregular variation, perhaps due in part to conflict of forces, as between rotation and revolution, or to a strain in reciprocal tides, but it seems to be stabilised through a number of cycles. M. A. E.

102. Titanium Oxide and Zirconium Oxide Bands in Stellar Spectra. R. S. Richardson. *Mt. Wilson Observat. Contrib. No.* 479. *Astrophys. J.* 78. *pp.* 354–358, *Dec.*, 1933.—The percentage of ZrO and TiO molecules dissociated at different temperatures and pressures has been calculated. The behaviour of the ZrO and TiO bands in S- and M-type spectra is discussed on the basis of these calculations. AUTHOR.

103. Spectrum of δ Cephei. C. J. Krieger. *Astrophys. J.* 79. *pp.* 98–139, *Jan.*, 1934.—On four one-prism spectrograms of δ Cephei the wave-lengths of 380 absorption lines were measured from $\lambda 4000$ to $\lambda 4750$. The intensities of the lines at maximum and minimum phase were estimated on an arbitrary scale. The contributors to the lines were identified, and are shown in a table. Elements definitely or probably present are: H, C, Mg, Si, Ca, Sc, Ti, V, Cr, Mn, Fe, Ni, Sr, Y, Zr, Ba, La, Ce, and Eu. A few other elements are possibly present. There are 68 lines which are probably unblended. The variation of intensity of lines is studied, first, by means of the unblended lines of the various elements; second, by means of the important contributors to the blended lines. Many lines to which neutral Ca, Ti, Cr, Fe, or rare earths contribute are strengthened at minimum, while some lines to which H or ionised Cr and Fe contribute are weakened at minimum. AUTHOR.

104. Hydrogen Line Widths in 5 κ Draconis. R. N. van Arnam. *Astrophys. J.* 79. *pp.* 140–143, *Jan.*, 1934.—Contours of $H\beta$, $H\gamma$, and $H\delta$ from twelve spectrograms of 5 κ Draconis, in which double emission components are superposed on the absorption contour of $H\beta$, fail to show correlation between intensity of emission and width of absorption wings. This is taken as added evidence in support of the hypothesis that these lines originate at different levels in the star. AUTHOR.

105. Radiation Measurements from Variable Stars. E. Pettit and S. B. Nicholson. *Mt. Wilson Observat. Contrib. No.* 478. *Astrophys. J.* 78. *pp.* 320–353, *Dec.*, 1933.—The observations were made with the vacuum-thermocouple on the 100-inch telescope during 1921–27, of 11 long-period variable stars, 5 irregulars, 2 Cepheids and Algol. Six long-periods (o Ceti, R. Leo. Min., R. Hyd., R. Ag and χ Cyg) were observed at all phases and their mean seems characteristic of their class, and show that the real energy maximum occurs 50 days later than the light maximum at a time when the star is 1·5 mag. fainter than its greatest brightness. The temperatures on the average range from 1800° K. to 2350° K. agreeing in phase with the light phases. The coolest star of Me type is χ Cygni and varies from 1630° to 2260° K.; if the variation is due to pulsation, the diameters are $0''\cdot 033$ to $0''\cdot 048$. R. Hydræ has the largest maximum diameter, $0''\cdot 065$. The velocity curve of o Ceti deduced from radiometer measures is in phase with what might be expected from the Cepheid but opposed to the spectroscopically observed phase. For M-type, red irregulars show small radiometric magnitudes and 5 N-type stars show the same characteristic; among these, V Cygni shows the lowest temperature (less than 1500° K.) of any star. The faint stars with large colour excess cannot be classed as giant Me stars at minimum. The Cepheids, η Aquilæ and δ Cephei give variations in radial velocity too small for detection by radiation measurement. The eclipsing companion of Algol is of early type but later than its primary. The difference in their temperatures is too small to determine by water-cell absorption. The photoelectric range is 0·12 mag. greater than the radiometer; and the photo-electric magnitude is fainter than the radiometer, not only at mid-eclipse where the difference is greater, but throughout the period of occultation and this is probably due, indirectly, to the lower temperature of the occulting star. A. S. D. M.

106. Colour Temperatures of B-Type Stars and Rayleigh Scattering. O. Struve, P. C. Keenan and J. A. Hynek. *Astrophys. J.* 79. *pp.* 1–7, *Jan.*, 1934.—Observations of two red B stars indicate that their energy-curves are consistent with Planck's law for temperatures which are considerably lower than those usually attributed to normal B stars. The results are not in harmony with Rayleigh scattering, but do not disprove other types of scattering. AUTHORS.

107. Mass of the Gas Ejected from a Nova. V. Ambarzumian and N. Kosirev. *Zeits. f. Astrophysik,* 7. *pp.* 320–325, *Nov.* 12, 1933.—The mass of gas which is ejected in the form of spherical shells in a Nova outburst is calculated and found to be of the order of 0·00001 ⊙. G. C. McV.

108. Observational Confirmation of Rotation of Galaxy. J. S. Plaskett. *Observatory,* 56. *pp.* 328–332, *Nov.*, 1933.—After Lindblad's theory appeared in 1927, Oort developed simple relations that must exist among radial velocities and proper motions of a rotating stellar system with central matter concentration. The author gives a summary of the present status of the problem including the latest evidence. (1) an analysis of radial velocities of 314 stars and of the intervening diffuse matter; these both are divided into 2 groups according to the strength of the interstellar lines and distance, and give values of variational terms of + 5·25 and + 10·97 km./sec. corresponding to average centres of distances about 300 and 650 parsecs respectively, and to longitudes 331°·3 and 331°·1; (2) 849 O to B7 stars divided into 4 groups, a general solution being made for a common solar motion and K-term and individual rotational terms and direction of centre. The two more distant groups (O to B2) give rotational terms + 9·7 and + 18·0 km./sec. with directions of centre of 326·7 and 322·3, and evidently show differential rotational effect. The nearer groups (B3 to B7) give less convincing effects. (Both (1) and (2) are by Plaskett and Pearce). (3) A. H. Joy gives the radial velocities of 124 Cepheids down to about the 14th magnitude, and is valid to distances up to 6000 parsecs. These are divided into 4 groups all showing rotational effect, which, however, does not increase linearly with the distance as determined photometrically from the period-luminosity relation. This difficulty is solved by the assumption of absorbing material such as decreases the apparent brightness of the stars by 0·85 pg. mags. per 1000 parsecs, the 4 groups being thus harmonised. This value for space absorption agrees with that of Stebbins from colour excess of globular clusters and B-type stars. Again this applies to the more distant stars, the anomalies in the stars near the sun being attributed to small systematic streams or other motions. [See following Abstract.]

A. S. D. M.

109. Colour Excess in Galactic Star Clusters. R. S. Zug. *Lick Observat., Bull. No.* 454. *pp.* 119–142, 1933.—The author gives an account of the gauging of selective absorption of light in space. Trumpler has supplied a differential method through the determination of colour-indices by means of the " half colour filter," permitting of homogeneous determinations in widely separated regions. The author finds the magnitudes, colour indices and colour excess for individual stars in 23 open galactic clusters and gets a mean value of colour excess derived for each cluster. The effective wave-lengths are 4300 and 6200 Å ; on the assumption that the colour excess is due to the uniform distribution of small particles in the sun's neighbourhood, the coefficient of selective absorption is found to be 0·36 mag. per 1000 parsecs, the residuals being strongly dependent on longitude. This suggests that the density of the interstellar absorbent increases along a density gradient of 27° galactic longitude and decreases in the opposite longitude. Colour excess (E) is expressed by $E = -0{\cdot}10 + 0{\cdot}36\,r + 0{\cdot}07\,r^2 \sin(117^\circ - L)$. The clusters N.G.C. 6823 and 7510, estimated at about 4000 parsecs distance in galactic longitudes 27° and 79° show no greater colour excess than clusters at half that distance, indicating that in these directions the absorbent material thins out beyond 2000 parsecs. The author suggests that the sun lies some distance from the maximum density, perhaps in a spiral arm of the galaxy. The excess of stars in galactic longitude 240° (the local cluster) may be due to the thinning out of the absorbent in this general direction. [See preceding Abstract.] A. S. D. M.

110. Relation of Velocity of A Stars to Galactic Plane, and Galactic Rotation. C. Bertaud. *Comptes Rendus*, 197. *pp.* 1098–1100, *Nov.* 13, 1933.—The author groups 523 A stars (407 after excluding known streams) according to distance from the galactic plane, each group being 10 parsecs broad. The group velocities show no clear dependence on the distance z ; but those within 20 parsecs of the galactic plane differ from the remainder. The author uses 449 of the stars to determine by a method of Mineur the centre of galactic rotation and the values of the constants A and B of Oort's equations ; the results differ conspicuously from the mean of the determinations. T. L. M.

111. Photometric Observations of RS Ophiuchi. (Miss) F. Bloch, J. Ellsworth and S. P. Liau. *Comptes Rendus*, 197. *pp.* 1095–1097, *Nov.* 13, 1933—Details of the authors' visual and photographic observations during decline from the high maximum of 1933, August, are given. Oscillations similar to those of Novæ appear. The resulting direct determinations of colour index show marked reddening. T. L. M.

112. Nova Ophiuchi 1901 (RS). H. S. Jones. *Observatory*, 56. *pp.* 332–335, *Nov.*, 1933.—Outbursts in this star have been observed in 1898 when it was of small range but undoubtedly Nova-like ; in 1900 and in August 1933. It was less than mag. 7·5 on August 10, but on August 11, 12, 13, 14 and 15 it was of mags. 5·8, 4·3, 5·1, 5·8 and 6·2. On August 16 the spectrum showed strong bright hydrogen bands, and there was ionised iron but no forbidden bands ; on September 3 the 4640 Å Nova-line was bright, and the doubly ionised oxygen line 4363 Å, but these weakened by September 19. On October 2 a spectrogram taken at Mt. Wilson showed the green coronal line 5303 Å and the red coronal line at 6274 Å. These two coronal lines had appeared within the three preceding weeks. The structure of the green line was very similar to that of the ionised helium line at 4686 Å. This is the first occasion on which the coronal lines have been identified in the spectrum of any star. At Harvard,

D. Menzel has identified three of the strong coronal lines as being due to neutral oxygen atoms in a peculiar state of excitation. The 1933 outburst of RS Ophiuchi is more typically Nova-like than the 1898 one, and resembles somewhat T Pyxidis. The author says that probably we must recognise a class of recurrent Novæ, whose cause may or may not be similar to Novæ of a single brightening. Such recurrent Novæ are not consistent with Milne's theory. A. S. D. M.

See also Abstracts 58, 86, 87.

SUN.

113. Photometric Study of Sunspots and Faculæ. R. S. Richardson. *Mt. Wilson Observat. Contrib. No.* 480. *Astrophys. J.* 78. *pp.* 359–371, *Dec.,* 1933.—The intensities of sunspots and faculæ at different distances from the centre of the sun's disc, relative to the intensity of the surrounding photosphere, have been determined from the direct photographs of the sun taken at Mt. Wilson since 1925. The photographs were calibrated by assuming that the intensity across the disc for the effective wave-length of the plate corresponds to that given by Abbot. Direct standardisation of plates of the same brand by diaphragming the objective shows that on the average they do not differ from Abbot's intensities by more than 4 %. The measurements on sunspots indicate that the ratio of intensity of any part of the spot to that of the surrounding photosphere is independent of the distance from the centre of the disc. The observations can be represented better by assuming that sunspots are in radiative rather than in adiabatic equilibrium. The relation between the intensity and the area of sunspots was investigated by measuring the intensity of the penumbra in fifteen spot groups. The areas of the individual spots, corrected for foreshortening, ranged from 78 to 2860 millionths of the sun's visible hemisphere. The logarithms of the areas plotted against the intensity ratios, penumbra/photosphere, indicate a roughly linear relation. The intensity of the faculæ relative to the surrounding photosphere was measured at various points between 0·60–0·95 of the distance from the centre of the disc to the limb. Minnaert and Wanders have advanced a theory of the faculæ based on the fact that a rising column of gas expanding adiabatically will be brighter than its surroundings if the ratio of the specific heats is less than 1·33. A fair agreement with the observations can be obtained by assuming a ratio of specific heats equal to 1·14.

AUTHOR.

See also Abstracts 112, 136.

V. 19

GEOPHYSICS.

GEODESY.

114. Errors of a Divided Instrument-Circle. F. Mühlig. *Zeit. f. Instrumentenk.* 53. *pp.* 477–485, *Nov.*, 1933.—The errors of the graduation of an azimuth circle were determined in the field, and were found to be much greater than errors obtained by microscopic examination in the Potsdam Geodetic Institute. The cause was found to lie in the method of fixing and the clamping of the circle in the actual instrument. The paper gives details of the investigation, discusses the source of such errors, and recommends that graduation errors be determined in the field as well as in the laboratory. W. A. R.

GEOPHYSICS, APPLIED.

115. Electrical Methods of Geophysical Prospecting. J. M. Bruckshaw. *I.E.E., J.* 72. *pp.* 521–533; *Disc.*, 533–541, *Nov.*, 1933.—Geo-electrical methods of prospecting depend on the marked differences in the resistivity which exist between adjacent geological formations, these differences being produced by variations in the porosity of the rocks and in the nature of the saline solutions which they contain. Minerals with a metallic lustre usually have a low resistivity. The variations in resistivity are revealed by the anomalous flow through the ground of an applied current, and the work consists in determining the current flow and interpreting the anomalies in terms of geological structure. The usual methods employed are the surface-potential methods (*i.e.*, the resistivity method, equi-potential-line methods, and equiquadrature methods, etc.), and the inductive methods at high and low frequencies, in which the current distribution is examined by means of the magnetic field associated with it. The methods may be applied to the location of good conducting ore bodies, faults, and dykes, to the measurement of depths, and also for the plotting of sub-surface contours. Under favourable circumstances sulphide bodies may be detected by the natural currents which they produce (spontaneous-polarisation method). AUTHOR.

116. Magnetic Vector Method for the Investigation of Regional and Local Geological Structure and its Application to Magnetic Disturbances over Europe. W. P. Jenny. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 187–197, 1933.—The magnetic vector method possesses the advantage over other methods in that it can be measured in three dimensions and in surveys the normal field can be separated from regional and local fields. The normal field for declination, N–S horizontal intensity, and vertical intensity is first obtained and by difference from the observed values the quasi-absolute disturbance values are calculated and plotted at each station by means of a vector triangle. In this way magnetic " highs " and " lows " (*i.e.*, places of high or low magnetic permeability) are determined corresponding to any geological disturbance of a structural or petrographic nature and the magnitude and direction of the magnetic disturbance evaluated. Mostly primitive rocks when near the surface cause a large positive magnetic anomaly but sedimentary rocks cause a weak negative anomaly. The charts obtained are similar to those of

Nippoldt. A general discussion is given of the regional anomalies over Europe and for a section west to east at latitude 53°. R. S. R.

HYDROSPHERE, PHYSICS OF THE.

117. Radioactivity of Water from the Top of the Ballon d'Alsace. R. Delaby, R. Charonnat and M. Janot. *Comptes Rendus*, 197. *pp.* 1140–1142, *Nov.* 13, 1933.—Previous measurements made on waters drawn from some of the principal granite heights of the Vosges showed high radioactivity. The authors indicate the points where the spring water shows greatest radioactivity and deduce that this arises from contact with granite rocks. These points are high up on the mountain. They deal with streams and springs lower down the slopes and show that there the radon content is much less. An extension of the work to an area west of the Ballon d'Alsace is discussed. There the springs, the waters of which come in contact with granite, prove to be the most radioactive. They consider that their observations support their previous hypothesis of the origin of the radioactivity in spring water. A. E. M. G.

118. Electrical Properties of Sea Water for Alternating Currents. R. L. Smith-Rose. *Roy. Soc., Proc.* 143. *pp.* 135–146, *Dec.* 4, 1933.—This paper describes a laboratory investigation of the electrical properties of sea-water under a.c. conditions, with particular reference to radio frequencies. A summary of previous work carried out at various frequencies up to 1100 kc. is given, and the experiments described afford a confirmation of the more recent results of this work together with an extension of the range of frequencies to 10,000 kc. It is concluded that the specific conductivity of sea-water obtained from the English Channel increases from $3 \cdot 9 \times 10^{10}$ e.s.u. at a frequency of 500 $\sim$ to $5 \cdot 4 \times 10^{10}$ e.s.u. at a frequency of 10,000 kc. and at a temperature of 20° C. (The corresponding resistivity values are 23 and 16·5 ohm-cm. respectively.) Evidence is given in the paper for concluding that in determining the current flowing in the sea-water within the above frequency range, the part played by the dielectric constant is negligible in comparison with the effect of the conductivity. The actual value of the dielectric constant is probably about 80 as for distilled water, the very high apparent values obtained at audio and at low radio-frequencies being attributed to the effect of polarisation films formed at the contact between the electrolyte and the electrodes. Measurements of the conductivity carried out at different temperatures indicate that between 0° C. and 40° C. the mean temperature coefficient is about $+ 2 \cdot 7$ % per degree C. A sudden decrease in the conductivity was observed to occur at a temperature of about $- 2°$ C., and below this transition point the temperature coefficient has a much smaller value. [See Abstract 3434 (1933).] AUTHOR.

See also Abstracts 146, 157.

LAND, PHYSICS OF THE.

119. Exhalation of Radon from the Soil and its Dependence on Meteorological Factors. W. Kosmath. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 226–237, 1933.—A critical examination is made of former determinations of the intensity of radium emanations from soil by Joly and Smith and a full description is given of improvements in the method so as to obtain results free from error. Sketches, with full details, show how the emanation is drawn into the ionisation chamber and how its intensity is then measured electrically. It is claimed that the method gives results correct to within 5 %. H. M. B.

120. Dependence of Soil Temperature on Outer Meteorological Factors. J. Siegenthaler. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 305–332, 1933.—Temperatures of the soil were taken at depths of 10, 20, 50 and 100 cm. at 7, 14 and 21 o'clock daily. 1 sq.m. of well-drained soil, light on the top and without vegetation was used. The snow was not removed in winter. Results are examined for the period 1918–1930. Primarily, the soil temperature depends upon its own thermal properties, but these may be changed by outside action, for instance, after rain, when the interstices are filled with water, the thermal conductivity of the soil as a whole will be quite different from a time when it is dry and porous. The outer temperature may also directly affect the soil temperature. H. M. B.

121. Heat Generated on Wetting Dry Earth. P. Hagene. *Comptes Rendus,* 197. *pp.* 935–937, *Oct.* 23, 1933.—Samples of earth from the roots of willow and ash trees were dried at 105°–110° C., and the heat generated by wetting measured in a water calorimeter. The results were compared with the loss of weight on calcination (a measure of the content of organic matter), and the " coefficient of wilting," an experimental quantity devised by Briggs and Shantz to indicate the available water. A general proportionality of the three quantities for these samples was observed, but deviation occurred when earths containing less organic matter were investigated, and it was concluded that the " coefficient of wilting " and heat generated on wetting were not determined by the same factors. R. F. A.

122. Final Distribution of Retained Liquid in an Ideal Uniform Soil. W. O. Smith. *Physics,* 4. *pp.* 425–438, *Dec.,* 1933.—The problem is considered for an ideal soil, that is an assemblage of spheres, of a single size, packed at random. There are in the ideal soil three types of distribution. First, there is a pendular region where the liquid is retained in the form of single rings of liquid wrapped around the axis of each pair of adjacent grains in contact. Second, there is a funicular region, which may be considered to arise by coalescence of the rings ; we have two or more grain contacts imbedded in a single liquid mass, that is, webs of liquid enmeshing two or more grain contacts and which may involve many grains of the packing. There is, finally, a saturation region in which all pores are completely filled. The limits of each of these zones are determined. The funicular zone is a zone of hysteresis and all values between a normal minimum and complete saturation are usually possible. To calculate the normal minimum distribution the actual packing is replaced by an average packing of grains in hexagonal array and equally spaced to give the required porosity. The distribution, that is, the liquid retained in any lamina at a height h above the free liquid, is also given. The results are compared with the data of King. AUTHOR.

See also Abstracts 56, 132, 323.

METEOROLOGY.

123. Temperature of the Stratosphere. K. Wegener. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 345–352, 1933.—The stratosphere can be divided into the lower stratosphere from 10 to 30 km., the upper from 30–70 km., and the high or aurora stratosphere from 70–250 km. There is a temperature inversion at 10 km., the tropopause, and the layer between this and 30 km. is nearly isothermal. At 70 km., there is a second sharp discontinuity as shown by reflection of sound waves. In the high stratosphere the temperature must certainly be less, if only by a small amount, than in the lower stratosphere and the density discontinuity at 70 km. is probably due to a different molecular constitution. The " Heaviside layer " is not yet fully understood. H. M. B.

124. Effective Radiation of Heat from the Sky during the Day in Relation to Solar Altitude and Degree of Obscurity in the Atmosphere. F. Steinhauser. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 342–344, 1933.—The author criticises Meyer's conclusion [see Abstract 2892 (1933)] that the summer intensity of the effective sky radiation incident on a flat surface increases with increase of solar radiation, reaching a maximum at 30°–35° altitude and then decreasing. The author uses the Stefan-Boltzmann law and the temperature of the actinometer to calculate the radiation outgoing from the actinometer, and from this values of the counter radiation of the atmosphere are obtained and tabulated. This shows that the counter radiation increases continuously with increase of solar radiation and the maximum of the effective radiation shows above all as an effect of temperature increase of the actinometer. This is also discussed in relation to the decrease of the effective radiation with increase of height above sea level since the latter usually involves a fall of temperature. R. S. R.

125. Structure of the Great Cold Burst at the End of November, 1930. E. Ekhart. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 134–176, 1933. —Section 1 gives by means of isochrones a complete representation of the cold wave during its travel from Iceland to Iraq and Egypt, and, in its extent, this invasion of polar air is similar to the cold waves in Russia and Siberia treated by Ficker. In Section 2 the changes in pressure distribution preceding the cold burst are outlined and it is considered that the impulse causing the eastward movement of the occlusion arose from an area of rising pressure in the upper atmosphere arriving from S.W. In parts of England the autographic records show the separate arrival of the occlusion and a secondary cold front. The barograms in southern England are grouped into three types showing the rise of pressure in the lower levels (*a*) during the fall, and (*b*) during the rise of pressure in the upper levels, and (*c*) an intermediate type. The area of rising pressure in the lower levels advanced more rapidly S.E. than that in the upper levels advanced N.E. In Section 3 pressure changes at the ground are examined and a model shows the crossing and amplitude of the two pressure waves. In Section 4 the thermal changes during the invasion of cold air are identified by the equivalent potential temperatures and their distribution is shown in figures for four successive days. From these figures an explanation follows that the cold wave advances along the direction of minimum resistance. In Section 5 cross sections illustrating the features of the cold wave are shown and discussed for (*a*) S.W.–N.E. along the track of the area of rising pressure in the upper levels, (*b*) N.W.–S.E. along the track of the polar

V. 19

wave, and (*c*) W.-E. along the track of the cyclone. The records of temperature and pressure at a number of stations are discussed and interpreted. From the analysis it followed that the maximum amplitude of the pressure wave in the lower layers due to the polar air invasion was one-third of that for the wave from south-west in the upper layers of the atmosphere. R. S. R.

126. Wind Flow over an Ice-Covered Sea. J. E. Fjeldstad. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 348–355, *Oct.,* 1933.—The author refers to an earlier paper [see Abstract 3060 (1930)] in which flow of the sea was produced by wind and the equations of motion for non-steady flow were integrated. In the present case the sea surface is considered to be covered by drifting ice and a full mathematical treatment is given with a new method of integration. Values are obtained for steady flow and the decrease in intensity when the flow suddenly ceases. Numerical examples are given for (1) a free sea surface, and (2) a surface covered with drifting ice, and the development of the surface flow assuming a constant wind at 3, 6, 9, 12 and ∞ hours after a zero instant. The ice covering is shown to produce a remarkable deviation in the direction of the wind while the velocity of flow is somewhat reduced compared with the value for a free water surface. R. S. R.

127. Cellophane as a Humidity Measurer. E. Schweitzer. *Naturwiss,* 21. *pp.* 784–787, *Nov.* 3, 1933.—Cellophane is very permeable to water vapour and rapidly adjusts itself to changes in relative humidity of the surrounding air as is shown from tests at 30, 50, 60, 80 and 95 %. It is consequently of use to surround a hair hygrometer with cellophane and provide protection to the hairs from dust, salt particles or other impurities. Its water content also depends on the relative humidity and it can be used as a hygrometer from this variation. If impregnated with cobalt chloride the change of colour with relative humidity can be used directly or from the transmission of short wave ultra-violet light. If artificially aged the change of length of cellophane can be used directly for determination of changes in relative humidity. The water content of the cellophane can also be determined in terms of the pressure required to burst a sheet of it. R. S. R.

See also Abstracts 119, 120, 226.

SEISMOLOGY.

128. Long Waves in the First Phase of Seismograms. O. Somville. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 333–338, 1933. *In French.*—Recent seismograms showing PL waves are figured and their meaning discussed [see Abstracts 1552 and 4154 (1932)]. It is suggested that such waves are due to slow oscillations produced at the lower surface of the crust; waves so produced would be rapidly damped, though part of the energy would be apparent at the upper surface of the crust. C. A. S.

129. $\overline{\text{P}}$ Waves. P. Caloi. *Com. Naz. Italiano, Geod. e Geofis., Boll.* 3. *pp.* 25–46, *Aug.,* 1933.—The Galitzin method is used to calculate the depth of epicentres, and applied to the disturbance in South Germany on November 16th, 1931. The depth of the epicentre for this shock is now found to be 52·3 km.—a value lying between the extremes obtained in the calculations of earlier workers. The velocity of propagation of the

$\overline{P}$ wave, its angle of emergence, and its time of transmission are worked out. Finally, a new, approximate, but quite accurate method for more easily calculating the epicentral depth is given. W. A. R.

130. Initial Earthquake Motion. T. Fukutomi. *Tokyo Univ. Earthquake Research Inst., Bull.* 11. *pp.* 510–529, *Sept.*, 1933. *In English.*—Eighty-six earthquakes that occurred in 1914–23 and 250 in 1923–31 in the Kwanto district have been classified according as the initial vertical motion recorded at Hongo was upward (41 and 134) or downward (45 and 116); the directions of several of the second series at three other stations is also recorded, sometimes coinciding with that at Hongo, sometimes the reverse. The distribution by locality of epicentre shows some regularity as regards those of like initial movement, and also of those with a nodal ellipse as opposed to a hyperbola, indicating the probability that a similar mechanism is at work over a considerable area. As regards focal depth earthquakes with a nodal hyperbola predominate when the focal depth is < 25 or > 50 km. those with a nodal ellipse for intermediate depths. C. A. S.

131. Artificial Vibrations of Ground. S. K. Banerji and M. D. Manohar. *Indian Journ. Phys.* 8. *pp.* 95–121, *Oct.* 7, 1933.—A weight of 12·7 kg. was dropped through 91·4 cm. at varying distances (1·83–31·4 cm.) E., W., and N.E. of two Milne-Shaw horizontal and a vertical component seismographs. These show first a sudden impulse, the maximum being attained at about the third vibration. The period is a compound of the free period of the building in which the instruments were placed (0·014 sec.) and of that of the forced vibration of the ground, which depended on the duration of impact and the elastic constants of the ground, and was found to agree fairly with that theoretically determined. The amplitude decreases approximately linearly with the distance of the weight. With a larger weight (120 kg.), meeting the ground at 4 m./sec., the amplitude of the horizontal component (at Colaba, Bombay) is about 5 and 12 μ for distances of 20 and 10 m. respectively, and the period of the forced vibrations about 0·05 sec. C. A. S.

132. Search for the Mechanism of Earth Movements. R. G. Lewis. *Geolog. Mag.* 70. *pp.* 499–521, *Nov.*, 1933.—From an examination of the levels of raised beaches, and kindred phenomena, at different places, it appears probable that a rise and fall of any part of the earth's surface is due to the passage of a wave through the crust. Such may travel either (*a*) at the depth of isostatic compensation, and be caused by the movements which accompany mountain-building, in which case the rise and fall will be approximately equal; or (*b*) at a lesser depth where a layer has become molten through radioactive heating of the sub-crust, and in this case a small rise is followed by a long, slow fall, and areas may be raised into domes by collapse of surrounding areas, when the central area will be a seat of volcanic activity. W. A. R.

133. Deep-Focus Earthquakes. V. Conrad. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 113–133, 1933.—Data for 196 deep-focus earthquakes during the years 1919–28 were extracted from the International Seismological Summary. These occur most frequently in the Pacific Island Archipelago north of Australia and New Zealand and thence northwards to Japan. Smaller numbers occur in the S. American Cordilleras, Central America and the Himalayas, and these groups are dealt with separately for periodicities. No periodicity with the length of a day or a concentration round full or new moon could be found. From monthly frequencies a periodicity of one year is not improbable but one of six months is more probable. This was also shown in the author's investigations on shallow-focus earthquakes. When grouped in tenths of a year the periodogram of the frequency of these earthquakes does not show a trial period for which Schuster's criterion would indicate reality. There are sharp peaks at 0·5, 1·0 and 1·2 years. The period 0·5 year found here and in earlier papers indicates the rotation of the earth's pole as the cause of variations in frequency. Pollak found in the rotation of the earth's pole harmonic components only for 1·0 and 1·2 years, and further data will probably confirm this conclusion for deep- and shallow-focus earthquakes. From the scanty material the frequency of earthquakes with a more shallow focus shows fairly clearly the half year periodicity. R. S. R.

134. Deep-Focus Earthquakes and other Geophysical Phenomena. H. Landsberg. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 238–243, 1933.—The frequency of deep-focus earthquakes is found to be greater at the equinoxes than at the solstices, at which times the variation of the earth's magnetism, the appearance of the aurora and so forth are similarly greatest and least. It is unlikely that there is a close connection between earthquakes and these other phenomena, as the latter are due to changes in the higher atmosphere. However, violent movements of the lower atmosphere at the equinoxes may affect the upper atmosphere and at the same time cause a polar shift which would facilitate earth shocks.

H. M. B.

See also Abstract 56.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

135. Ball Lightning. E. Mathias. *Comptes Rendus*, 197. *pp.* 962–964, *Oct.* 30, 1933.—The author first defines a material body and then shows that ball lightning (*reste d'eclair spherique*) behaves as such a body, by referring to its various qualities such as volume, mass, etc. Thereafter by reference to observations made at various times and in different places he points out that it has been seen to exist in media as different as water and air, and to pass from the one to the other. He further considers that as the ball moves onwards it is transformed into mechanical work and in so doing its volume decreases steadily. Examples are again cited in support of this idea. A. E. M. G.

136. Electric Field at Ksara Observatory during the Solar Eclipse of August 21, 1933. J. Chevrier. *Comptes Rendus*, 197. *pp.* 1143–1145, *Nov.* 13, 1933.—Observations of the electric field have been made at Ksara since August, 1932. The drum of the recording electrometer revolves slowly, and so to find a record of the variations, eye readings were made at every 2 minutes between 4h. 30m. and 7h. 30m. from 18th to 24th August inclusive. From these, means of the gradient for the hours of 5, 6 and 7 on these days are calculated and agree with the hourly means for both August, 1932, and August, 1933. The variations of the gradient are also found, and tabulated. Those for the 21st, the day of the eclipse, the maximum of which occurred at 5h. 58m., show a marked difference from the others, the normal increase of the gradient being retarded. These results are comparable to others previously obtained elsewhere. The author gives the results with a certain reserve remarking that at the hours considered the gradient often shows large variations on days otherwise quiet. A. E. M. G.

137. Variation with Temperature of the Electrification Produced in Air by the Disruption of Water Drops and Its Bearing on the Prevalence of Lightning. J. Zeleny. *Phys. Rev.* **44.** *pp.* **837–842,** *Nov.* **15, 1933.**—The total charge carried by the negative ions which are produced in the air when a water drop is disrupted by falling through a horizontal stream of air was measured for different stream velocities at temperatures between 1° C. and 63° C. The dependence of this charge upon the size of the drop was found from observations made with drops differing in volume between 0·076 c.c. and 0·092 c.c. For blasts exceeding that necessary just to disrupt the drops, the charge obtained per drop disrupted increases rapidly both with the velocity of the blast and with increase of temperature. The rate at which the charge changes with increase of temperature of the drop depends upon the magnitude of the air stream employed for producing the disruption. For drops of 5·8 mm. diameter falling from a height of 2 cm. through a horizontal cylindrical stream of 1 cm. diameter and having an average velocity of 20 m./sec., the relation between the numbers of negative ions produced per drop disrupted at the temperatures 1·3° C., 24·2° C, 42·1° C and 62·5° C, respectively, was found to be 1 : 3 : 6·4 : 11. In the range of temperatures found in the atmosphere at different times the amount of electrification produced in the air when raindrops are disrupted by air currents of a given magnitude may be at least three times as large when the rain-water is warm as when it is cold. Rain temperature is therefore an important factor in determining the frequency and the intensity of lightning discharges. AUTHOR.

138. Electronic Bombardment as a Factor in Atmospheric Phenomena. C. Jensen. *Gerlands Beitr. z. Geophys.* **40. 2–3.** *pp.* **198–205, 1933.**—The author criticises in detail the conclusions drawn by Cohn [see Abstract 986 (1933)] regarding the blue colour of the sky, and atmospheric polarisation phenomena. Among the several points discussed are (1) the anomalies in spectral distribution in the light from the blue sky, (2) effect of volcanic dust in the upper layers, (3) depth of colouring in different latitudes, (4) limiting wave lengths in the fluorescent light, and (5) variation of polarisation with solar altitude. Reasons are given why Cohn's views should not be accepted and alternative explanations are supplied. R. S. R.

See also Abstracts 116, 118.

RADIOACTIVITY.

139. Wave-Statistical Theory of Radioactive Disintegration. K. C. Kar and A. Ganguli. *Phil. Mag.* 16. *pp.* 1097–1109, *Dec.*, 1933.—Assuming that the phenomena of radioactive disintegration are due to a form of damping, a theory is developed from the Rutherford model for which the phase space of the core is very dense. The phase density gradually decreases and the phase space for the core becomes analogous to a compressible and viscous fluid. The fundamental wave-statistical equation, based on the assumption of compressibility, is modified for the core. From the wave functions in q and p space it is found that the circular or linear damping coefficient is proportional to the velocity of the emitted α-particle. The same problem is considered by taking into account the Coulomb potential outside the core, and gives for the damping coefficient about half the previous value. A relation found between the disintegration constant and the damping coefficient does not agree with the Geiger–Nuttall relation. Experimental and theoretical values of the disintegration constant for different radioactive substances are in good agreement, and the theory may be further improved by considering nuclear spin. N. M. B.

140. Thorium C″. (Miss) C. Chamié. *Comptes Rendus*, 197. *pp.* 1037–1039, *Nov.* 6, 1933.—To obtain thorium C″ by the recoil method a gold plate was spread with thorium active deposit, and on this was placed an ebonite ring with metal top about 2 cm. high, and thereon a metal plate maintained at negative potential, thereby freeing the air within the ring from charged dust. This was then replaced for about 10 sec. by the collecting plate for thorium C″. Saturation was obtained with a field of about 700 V./cm., and thorium C″ free from any trace of thorium C and giving a half-life period of 3·1 min. with one of 270 V./cm. Certain slight anomalies in the beginning of the decay curve of thorium C″, indicating excess activity, were as a rule noted. These are perhaps connected with the fine structure of α-rays from thorium C. C. A. S.

141. Absorption of Penetrating γ-Rays. W. Gentner. *Comptes Rendus*, 197. *pp.* 1111–1112, *Nov.* 13, 1933.—In the absorption of γ-rays of different wave-length by lead Chao notes irregularities of the coefficient of absorption for $\lambda 6 \cdot 6$X.U., where he finds the occurrence of a minimum of the ratio of the absorption of Pb to that of Al. The author points out that this minimum is due to the increase of nuclear absorption in lead and does not correspond to a special quality of the γ-radiation of $\lambda 6 \cdot 6$X.U. as regards lead. J. J. S.

See also Abstracts 117, 119, 306.

Note.—Starting with the current number, Abstracts on "Artificial Disintegration," "Neutrons" and "Nuclear Constitution" are in "GENERAL PHYSICS" under **Atomic and Molecular Structure.**

RADIATION.

ABSORPTION AND TRANSMISSION.

142. Absorption of Copper, Silver and Gold in Visible and Ultra-Violet. A. Smakula. *Zeits. f. Physik,* 86. 3–4. *pp.* 185–194, *Oct.* 31, 1933.—Measurements of thin layers of the metals were carried out photoelectrically in the region 700–186 $m\mu$, using a double monochromator. Reflection loss at the surface was taken into consideration so that the true absorption was found. The metals were evaporated on to quartz plates. Certain differences between different specimens of the same metal were found and were shown to be due to differences in the rate at which evaporation occurred. In addition to the characteristic transmission band in each metal a number of small maxima and minima were observed, the spacing of which was found to increase as the wave-length decreased. It is shown that the positions of the characteristic bands are not in accordance with certain theories and a theory is advanced in the case of silver. D. H. F.

143. Absorption of Light by Metals. A. Smakula. *Phys. Zeits.* 34. *pp.* 788–790, *Nov.* 1, 1933.—The absorptions of Cu, Ag, Au, Al, Sn, Pb, Sb, Bi, Cr, and Mn have been measured by a photoelectric method over the wave-length range 7000–1860 Å, account being taken of the light reflected at the surfaces of the thin films (condensed *in vacuo*) employed. The absorption of Ag is found *not* to fall off below 2500 Å. Cu and Au show no new regions of transparency in the ultra-violet, such as would be expected from Schubin's theory. The intensities of the absorption bands are discussed with reference to crystalline and colloidal states in the films, and to their electrical conductivities. C. B. A.

144. Lambert-Beer Law and the Nature of Absorbing Particles in Solution. E. Darmois. *Comptes Rendus,* 197. *pp.* 1120–1121, *Nov.* 13, 1933.—Assuming the Lambert-Beer absorption law to be true, it is shown how the absorption data may be used to determine whether new compounds are formed when solutions are mixed. H. H. Ho.

145. Quantitative Absorption of Thinly Blown Glass in the Ultra-Violet. Silvia Cristecu and S. Vencov. *Soc. Romăne Fiz., Bull.* 35. *pp.* 75–87, *June–July,* 1933. *In French.*—Thin films of Thuringia and Jena glass were blown and their thicknesses measured by an interference method. The absorption in the wave-length region 2300–3100 Å was determined by a photographic method, making use of microphotometer records obtained by a Moll microphotometer. The results are given in the form of curves relating the photographic blackening to the thickness of glass, the range of thicknesses being from a fraction of 1 to 200 μ. G. E. B.

146. Transmission of Ultra-Violet Radiation by Water. C. D. Hodgman. *J.O.S.A.* 23. *pp.* 426–429, *Dec.,* 1933.—Pure distilled water has been shown to be relatively transparent to ultra-violet radiation. Sea-water, however, has been found to be considerably less transparent. The presence of soluble mineral salts was judged to be the cause. Measurements made by the author for the fresh waters of certain lakes and streams in the vicinity of Cleveland indicate that although obviously carrying a far smaller mineral content, they also have a relatively low transmittance. Increased transmittance was found to result from passage of the samples through a Mandler filter cone of diatomaceous earth and also from the processes of coagulation and filtration to which the water of Lake Erie is submitted before being turned into the mains of the Cleveland Water System. It is concluded that the low transmittance of the fresh water cannot be ascribed wholly to dissolved mineral salts but must in part at least be due to scattering caused by the presence of fine particles.

AUTHOR.

See also Abstracts 148, 187.

COLORIMETRY.

147. New Method of Colorimetry. R. A. Houstoun. *Phil. Mag.* 16. *pp.* 945–953, *Nov.*, 1933.—An inexpensive and simple method of making absolute measurements of colour in terms of two colour coordinates is described. A spectroscope and quartz prism are used to produce two superposed white light spectra which are displaced relative to each other in a lateral direction and are polarised in planes at right angles to each other. The combination is examined through a Maxwell slit and nicol prism. By rotating the nicol prism when the telescope is in any direction the relative intensities of the two colours viewed can be varied. Thus by a suitable adjustment of the telescope and the prism any colour, except saturated pinks and purples, can be matched. It is shown how to apply the corrections necessary for deducing absolute values of the colour coordinates from the settings of the telescope and the prism when a colour match is obtained. It is possible to match some colours by two different telescope settings and in these cases the colour coordinates can be determined without attention being paid to brightness considerations.

J. E. R. C.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

148. Transversal Magneto-Optical Anisotropy of some Colloidal Solutions. Part II. Iron Oxide Sols. W. Heller and H. Zocher. *Zeits. f. phys. Chem.* 166. *Abt.A.* 5–6. *pp.* 365–381, *Oct.*, 1933.—The paper contains a general review of the magneto-optical behaviour of iron oxide sols. It is shown that the hitherto inexplicable complexity of the Majorana phenomenon in these sols becomes more orderly when four types of sol are distinguished. The subjects considered are the anisotropy of various sol-zones, the anisotropy of aggregates of particles, the effect of temperature and of other factors on the anisotropy, the orientation of iron oxide particles in the magnetic field, dispersion of the anisotropy, and the flow-birefringence. [See also Abstract 2351 (1933).] C. B. A.

149. Comparison with Experiment of the Quantum Theoretical Formulæ Relating to Electrical Double Refraction. T. Neugebauer. *Zeits. f. Physik*, 86. 5–6. *pp.* 392–410, *Nov.* 11, 1933.—In gases in the normal case the terms of the quantum theoretical formula corresponding with the orientation theory explain the Kerr effect. The terms corresponding with Voigt's theory have then a significance, if the molecule is symmetrical. In this case the classical formulæ which give a connection between Kerr constant and degree of depolarisation are no longer applicable. Similarly the Boltzmann distribution can also yield a limited Kerr effect with symmetrical molecules if in them an excited oscillation level lies deep enough. The order of magnitude of the terms is estimated and compared with experiment. In crystals which possess a coordination lattice double refraction exists only according to Voigt's theory. From the order of magnitude of the formulæ the magnitude of the internal crystal field may be estimated. In molecular lattices an orientation effect is also possible. J. J. S.

150. Paramagnetic Rotatory Polarisation. J. Becquerel and W. J. de Haas. *K. Onnes Lab., Leiden. Comm. No.* 217–228, *Suppt. No.* 74*a*. *pp.* 1–35, 1933. *In French.*—It is recalled that the Faraday effect has been separated into two parts related respectively to diamagnetism and paramagnetism. Experiments made at very low temperatures with minerals and uniaxial crystals which contain rare earths show that the paramagnetic rotation of the plane of polarisation ceases to be proportional to the magnetic field when H/T becomes sufficiently great. The law of paramagnetic rotation along the optic axis is expressed, in terms of a hyperbolic tangent and the report summarises previous results [see Abstracts 1814–1817 (1930), 1169–1175 (1931), and 1930 (1932)]. G. E. A.

151. Magneto-Optic Nicol Rotation Method for Quantitative Analysis of Calcium. Edna R. Bishop, C. B. Dollins and Irene G. Otto. *Am. Chem. Soc., J.* 55. *pp.* 4365–4370, *Nov.*, 1933.—A quantitative magneto-optic method for the determination of calcium on the Allison principle is described. The optimum concentration range is found to be between $3\cdot74 \times 10^{-9}$ and 1 gm. of Ca per litre. Results are independent of the presence of foreign substances and agree within 10 % with those obtained by permanganate titration. C. B. A.

152. Photoelectric Measurement of Magnetic Rotatory Dispersion in the Ultra-Violet. G. Bruhat and A. Guinier. *Comptes Rendus,* 197. *pp.* 1028–1030, *Nov.* 6, 1933.—By means of the authors' method [see Abstract 2981 (1933)] the magnetic rotatory dispersion, $m = \rho_\lambda / \rho_{4358}$, has been measured for water for eleven values of λ (5892–2482 Å), and also for heptane, heptene and heptinene for eight values (5893–2804 Å). The results agree well with theory. Verdet's constants and the molecular rotatory powers of the hydrocarbons in the liquid and gaseous states for the yellow mercury line are respectively 1·28, 1·47 and $1\cdot56 \times 10^{-2}$; 1·87, 2·07 and 2·03; and 1·52, 1·66, and 1·62; whence are deduced as the rotations for the double and triple bonds of carbon 27 and 35×10^{-2} respectively. [See Abstract 4050 (1933).] C. A. S.

See also Abstracts 10, 11, 154.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

153. Fluorescence of Lead Vapour. W. Kloskowska. *Acta Physica Polonica,* 2. 2. *pp.* 239–244, 1933. *In German.*—The vapour was obtained in an electric oven at 900°C. Under illumination with white light 121 bands were obtained in the region 4059–5136 Å and a series of bands in the region 3200–4100 Å. Under excitation with the Zn arc two resonance series were obtained: $\nu = 30108\cdot5 - 430\cdot75\ (p+\frac{1}{2}) + 2\cdot07\ (p+\frac{1}{2})^2$ and $\nu = 30684\cdot1 - 429\cdot4\ (p+\frac{1}{2}) + 1\cdot5\ (p+\frac{1}{2})^2$. In addition to these two Pb-molecule series two atomic lines 4058 and 3684 Å were obtained. As the exciting light does not correspond to an atomic absorption the atomic lines must be due either to dissociation of the molecules or to collisions of the excited molecules with normal atoms. A comparison with other instances in which these lines are emitted during dissociation of Pb molecules or of Pb compounds indicates that they are probably due to dissociation. J. E.

154. Magnetic Extinction of Iodine Vapour Fluorescence. J. Genard. *Comptes Rendus*, 197. *pp.* 1104–1107, *Nov.* 13, 1933.—Van Vleck has given the formula $Q=bH^2/a+bH^2$ connecting the enfeeblement Q of the fluorescence of iodine vapour with the exterior magnetic field H, where the quantity b/a is independent of H. The author has carried out an experimental study of the phenomenon using the electromagnet of the Academy of Sciences of Paris by which much higher fields than hitherto employed were obtained. The visible fluorescence of the iodine was excited by a very intense mercury arc. The photometric measurements were made on the terms 1 and 3 of the resonance series excited at the temperature of the room by the ray λ5461 HgI. This fluorescence was photographed in magnetic fields increasing from 0 to 42,600 gauss. The relative intensities of the lines in various magnetic fields are given and the results appear in good agreement with van Vleck's theoretical formula. In accordance with that formula the intensity of the fluorescence tends towards zero when the field increases indefinitely. J. J. S.

155. Polarisation of the Bands of Fluorescence of Hg Vapour. G. Zieliński. *Comptes Rendus*, 197. *pp.* 1109–1111, *Nov.* 13, 1933.—An account is given of experiments which prove that the system of bands first observed by Steubing in the series of the bands of fluorescence of the vapour of Hg are polarised. This system has a structure of fluctuations and is analogous to the bands of van der Lingen observed in the fluorescence of the vapour of Cd, in which polarisation was discovered. In the emission of Steubing's bands the collisions without doubt play the preponderant part. The degree of polarisation, P, is independent of the pressure of the vapour within wide limits. The value of P is equal to that found for van der Lingen's bands in the fluorescence of the vapour of Cd. J. J. S.

156. Theory of Phosphorogens. A. A. Guntz. *Comptes Rendus*, 197. *pp.* 1030–1033, *Nov.* 6, 1933.—It is known that the phosphorescence of certain substances is due to the presence of small traces of impurities called phosphorogens. The optimum concentration of the impurity is not fixed but depends on the mode of excitation, and decreases with increasing temperature. Coustal has prepared phosphorescent ZnS by explosive combination of Zn and S without apparent impurity. It is suggested that the rôle of the phosphorogen is that of a catalyser creating a photosensitive state of the base which may also be realised by other means. J. E.

157. Photographic Registration of Phosphorescent Matter by Long Exposure. P. Idrac. *Comptes Rendus*, 197. *pp.* 1142–1143, *Nov.* 13, 1933.—The present note discusses the results found with the aid of a substance rendered phosphorescent by the presence of radioactive material. The record is made on a film placed on a rotating drum. The method has been applied at the marine laboratory at Concarneau to the study of the direction of currents at the bottom of the sea. The simple apparatus required can be placed at any desired height above the sea bottom by using depth floats, thus getting rid of surface-float effects. It is hoped to employ this apparatus on the study of the deep waters of the Mediterranean. A. E. M. G.

See also Abstract 232.

INTERFERENCE. DIFFRACTION AND SCATTERING.

158. Diffusion of Light and Rotation of Molecules in Liquids. A. Rousset. *Comptes Rendus*, 197. *pp.* 1033–1035, *Nov.* 6, 1933.—The light diffused at right angles to the main beam consists of a continuous background superposed on the primary wave-length. The principal part of this scattered light is due to fluctuations of orientations of the molecules, which provide two wings to the original wave-length. Observations on the distribution of intensities permit the calculation of the depolarisation factor of the branches. The results are in accord with the theory of the spectra of rotation of polyatomic molecules of Placzek and Teller, but do not agree with those of Raman and co-workers. For associated molecules the total intensity of the two branches is less than theory indicates, suggesting that the forces which provoke association oppose certain rotations. Observations with a very fine slit show that the branches are not monochromatic. **Errata,** *ibid. p.* 1256, *Nov.* 20, 1933. J. E.

See also Abstracts 181, 216.

PHOTOCHEMISTRY.

159. Correlation of Spectroscopy and Photochemistry. W. A. Noyes, Jr. *Rev. Modern Physics*, 5. *pp.* 280–287, *Oct.*, 1933.—The manner in which spectroscopic and photochemical studies assist one another in the elucidation of molecular structure is discussed, and is illustrated by consideration of the results obtained in the study of the oxygen-ozone system and of acetone. In dealing with complex molecular species it seems doubtful if a spectroscopic study alone will succeed in describing and correlating adequately the various electron states and the possible dissociation products. Use must then be made of photochemical investigation, due care being taken in interpreting results, since chain reactions and various secondary steps may lead to products altogether different from those produced during the primary process. T. H. P.

160. Relationship of Structure to Developing Properties of Naphthalene Compounds. R. B. Forster and H. T. Hanson. *Phot. J.* 73. *pp.* 466–470, *Nov.*, 1933.—The literature of the subject is first reviewed, and the paucity of knowledge regarding the relationship of structure to the developing function in compounds of the naphthalene series emphasised. The following substituted naphthalenes have therefore been examined for the effect of the positions of the active groups, *viz.*: (1) 1-amino-2-hydroxy-, (2) 2-amino-1-hydroxy-, (3) 1-amino-4-hydroxy-, (4) 1 : 2-diamines, (5) 1 : 4-diamines, (6) 1 : 5-diamines, (7) amino and hydroxyl groups in different rings, (8) two hydroxyl and no amino groups, (9) 1 : 2-diamines with a hydroxyl group in the other ring, (10) 2-amino-1-hydroxy compounds with a second amino group in the other ring, and (11) 1-amino-2-naphthol-3-carboxylic acid and its arylamides. (1) appear to possess the developing function to the most marked degree, and the introduction of a sulphonic acid group is an advantage as it increases the

solubility of the compound. With the exception of 2-amino-1-naphthol-3 : 6-disulphonic acid, (2) possess a marked function ; some, however, are easily oxidised and give deeply coloured solutions. The introduction of the sulphonic acid group into 1-amino-4-naphthol, especially in 8-position, increases the developing activity considerably. (4) and (5) are active, (6) and (7) are inactive. (8) are also inactive, but the introduction of a hydroxyl group into the other ring of a 1 : 2-diaminonaphthalene sulphonic acid confers activity in 8- but not in 5-position. (11) show no regularity in behaviour. The effect of addition of alkali is discussed.
H. H. Ho.

161. Sensitisation of Infra-Red Plates. R. Mecke and A. Zobel. *Phys. Zeits.* 34. *pp.* 843–844, *Nov.* 15, 1933.—The best conditions are sought for the sensitisation of plates, for infra-red photography, by treatment in a bath of alcohol, ammonia and a neocyanine dye. It is found that the degree of sensitisation increases little with rise of temperature of the bath above 5° C. ; that the maximum effect is obtained with 5–7 c.c. of ammonia (0·920 specific gravity) to 100 c.c. of 50 % alcohol, being less if the concentration of the ammonia be more or less than this figure ; and that it is not possible to obtain definite results as to the effect of variation in concentration of the dye. Rapid drying after bathing is essential to avoid fogging.
D. H. F.

162. Development of Photographic Lenses at Leicester. W. Taylor and H. W. Lee. *Engineering,* 136. *pp.* 531–533, *Nov.* 10, 1933. *Abstract of paper read before the British Assoc., Leicester, Sept.,* 1933.—Following a survey of the historical development of lenses, in which it is pointed out that most of the fundamental improvements were introduced by Englishmen, culminating in the Cooke lens produced in 1893 by H. D. Taylor, general improvements in methods of comparing lenses are described. Developments at Leicester in the works of one of the authors are next considered, such points being included as the development of lens design, aspherical surfaces, lenses of large aperture, telephoto lenses, projection lenses, lenses for critical definition and for infra-red photography.
R. C. F.

163. Photogrammetric Apparatus. O. v. Gruber. *V.D.I.* 77. *pp.* 1177–1180, *Nov.* 4, 1933.—Briefly describes new and improved apparatus, developed in Germany, for photogrammetrical purposes. For geophotogrammetry the film photo-theodolite, and the panorama camera are considered, whilst, for aerophotogrammetry, an improved form of camera for vertical operation, as well as coupled cameras for taking two or four photographs simultaneously, are illustrated. Finally, different types of apparatus for measurement purposes in the two cases are dealt with.
R. C. F.

164. Pan-Stereoscopic Photography and Kinematography. H. E. Ives. *Phot. J.* 73. *pp.* 482–496, *Dec.,* 1933.—Critical review.

PHOTOMETRY.

165. Measurement of the Absolute Intensity of Light Using a Black Body at a Known Low Temperature. (Miss) J. G. Eymers and D. Vermeulen. *Rev. d'Optique,* 12. *pp.* 392–395, *Oct.,* 1933.—Details are given of a method used to calibrate in terms of energy, the spectral pyrometer of Ornstein, Eymers and Vermeulen for measuring the illumination of a surface by light of any wave-length. The method employs a black body at a relatively low temperature (gold point). W. S. S.

166. Recording Microphotometer. J. Weigle. *Rev. Sci. Instruments*, 4. *pp.* 595–597, *Nov.*, 1933.—A photoelectric cell is used to measure the intensity of the light passing through the photographic plate under investigation. A galvanometer whose mirror rotates about a horizontal axis records the current. It is mounted on a rotatable turret with the mirror exactly over the centre of rotation ; this is directly coupled to the stage carrying the plate, by means of a steel ribbon, in such a way that its rotation is proportional to the movement of the plate. The abscissæ on the record are thus directly related to the movement of the plate under examination. The accuracy of the instrument therefore does not depend upon the precision of screws or gears. D. H. F.

167. Unit of Light or Standardised Method of Measurement. L. S. Ornstein. *Rev. d'Optique*, 12. *pp.* 385–389, *Oct.*, 1933. *K. Akad. Amsterdam, Proc.* 36. 8. *pp.* 764–769, 1933.—The author criticises the preoccupation of photometrists with the idea of a standard of light. Physically the light emitted by a source is specified completely by giving the energy radiated per second per unit solid angle in each wave-length of the spectrum. The only fundamental standards or units necessary are those of length, mass and time. What is required is an internationally standardised method for measuring the absolute energy distribution. The photometrist's light unit, the lumen, embodies the physiological response of the eye as represented by the visibility curve, but since the efficacy of lighting is in many cases not correctly represented by this curve, the lumen number is frequently inappropriate and inadequate. Proposals are here made for the specification of the light given by continuous sources and spectral line sources, without introducing a special unit of light. The derivation of the lumen number from the new specification is obtained with the help of an agreed visibility curve which need not however be accurately determined as the mean visibility curve of the human eye. W. S. S.

168. Standardisation of Photometric Secondary Standards of Any Temperature. L. S. Ornstein, (Miss) J. G. Eymers and D. Vermeulen. *Rev. d'Optique*, 12. *pp.* 390–391, *Oct.*, 1933.—Since the existing primary standards of light give light of a relatively low colour temperature, the difficulties of heterochromatic photometry are encountered when secondary standards of higher colour temperature appropriate to practical requirements, have to be determined. Accepting an agreed visibility curve of the eye, the present method avoids heterochromatic photometry by utilising a photometric sphere into which are placed in turn (*a*) a lamp of known total lumens, (*b*) a lamp of known relative spectral energy distribution, and (*c*) the unknown secondary standard, and by measuring the relative intensity of the light issuing through the sphere window for these three cases, for each wave-length in the spectrum, with the aid of a spectrophotometer, the use of a black body is avoided. A precision of 0·5 % has been obtained using the method described and a numerical example is included. W. S. S.

POLARISATION.

169. Rotatory Power of Very Weak Solutions. I. Peychès. *J. de Physique et le Radium*, 4. *pp.* 594–608, *Oct.*, 1933.—A method is described for the polarimetric measurement of the rotatory power of solutions of the order 10^{-3} molecule per litre, and is applied to the determination of rotatory power-concentration curves for the alkali tartrates. Those of rubidium, cæsium and potassium rise linearly with the concentration ; those of sodium and lithium show a maximum. In all cases the curves converge near the origin, indicating the individuality of the tartarate ion of specific rotation 45·7°. It is concluded that the variation of rotatory power is a linear function of the ionic potential. N. M. B.

170. Photoelectric Polarimetry. G. Bruhat and A. Guinier. *Rev. d'Optique*, **12.** *pp.* **396–416,** *Oct.*, **1933.**—The authors indicate improvements made on the photoelectric polarimeter already described [see Abstract 2980 (1933)]. The amplification of the photoelectric current has been increased by increasing the filament-grid resistance of the first valve. By using an electrometer valve, the resistance in question could be raised to 10^{10}–10^{11} ohms, with which variations in the photoelectric current of 10^{-14} ampere could be detected. The analyser of the polarimeter is set so that when two similar plates of right-handed and left-handed quartz are interposed in turn, the photoelectric current shows no variation. The method gave maximum sensitivity when the quartz plates were of 0·1 or 0·2 mm. thickness, depending on the wave-length employed. Measurements on sugar solutions showed the polarimeter to have a precision of the order of 0·1 % (0·5 min. of arc), the main difficulty being the determination of the effective wave-length of the light employed. A study of several mercury arc lines was made to throw light on this point. W. S. S.

171. Compensator for Photographic Measurement of Polarised Light of Weak Ellipticity in the Ultra-Violet Spectrum. G. Szivessy, A. Dierkesmann and C. Münster. *Zeits. f. Instrumentenk.* **53.** *pp.* **465–477,** *Nov.*, **1933.**—A half-shadow instrument for the measurement, in the ultra-violet, of weak ellipticities of polarised light, or of phase-difference of weak birefringence, and the necessary technique, are described in detail. The theory of the method has already appeared elsewhere [see Abstract 2979 (1933)]. The accuracy obtainable is 0·2–0·3 % for an ellipticity greater than $5 \cdot 10^{-5} \cdot 2\pi$, and about 1 % for smaller angles. C. B. A.

See also Abstracts 138, 155, 295.

RADIATION, EMISSION.

172. Transmission of Waves Through an Ionised Gas. R. W. Revans. *Phys. Rev.* **44.** *pp.* **798–802,** *Nov.* **15, 1933.**—A discharge in mercury vapour at approximately 0·001 mm. pressure maintained in a 9 cm. spherical bulb between a hot filament and a nearby disc anode was found to become oscillatory at a value of the filament current which depended on the anode potential and was quite definite for a given voltage. By means of a movable probe, the energy of the electrons was determined at various points in the non-oscillating and in the oscillating discharge. When oscillations set in, the electron temperature increased markedly. The frequencies present seemed to consist of a fundamental and a long series of harmonics ranging from about 2×10^4 to 10^6 ∼. The fundamental was constant over a wide range of anode currents and voltages and its frequency was in good agreement with that calculated on the basis of J. J. Thomson's theory. The overtone that was most intense changed discontinuously with the anode current as though the discharge favoured one mode of oscillation at one time as does an organ pipe. It was concluded that the glow was vibrating as a whole in a manner similar to the air in a Helmholz resonator. A movable probe maintained about ten volts positive with respect to the filament collected currents that showed variations with position and had two or three marked maxima and minima along a diameter of the spherical bulb. In a long cylindrical tube, the currents collected by a probe moved along the tube axis showed no maxima or minima, but those collected by a probe moved along a diameter varied in a manner similar to those on the spherical bulb. AUTHOR.

173. Nature of Cosmic Radiation. W. Kolhörster. *Phys. Zeits.* 34. *pp.* 809–819, *Nov.* 15, 1933.—A review of recent researches on cosmic rays including consideration of the following: Methods of measurement, characteristics of the cosmic radiation, geographical distribution, latitude effect, geomagnetic distribution, azimuthal asymmetry, investigation of magnetic deflection, distribution of direction in the vertical, non-periodic variations, periodic variations, distribution as to height, secondary rays, transition effect, secondaries through several coincidences, cloud chamber photographs and the energy of the rays, cosmic rays as corpuscular radiation. J. J. S.

174. New Results in Cosmic Ray Measurements. E. Regener. *Nature,* 132. *pp.* 696–698, *Nov.* 4, 1933. *Paper read before the British Assoc., Leicester, Sept.,* 1933. *Phys. Zeits.* 34. *pp.* 820–823, *Nov.* 15, *and p.* 880, *Dec.* 1, 1933.—The results are given of recent measurements of the intensity of the cosmic radiation in the upper atmosphere. A new form of balloon electrometer was employed which has an open ionisation chamber communicating with the air outside through a tube containing P_2O_5. The pressure in the chamber decreases as the balloon rises and the ionisation chamber must be larger to obtain adequate sensibility. The arrangement is very convenient for measuring the absolute value of the ionisation for it is easier to obtain the saturation current at a low pressure. The results of the four best registrations are shown on curves. The first three ascents agree very well amongst themselves but in the upper atmosphere on the fourth ascent the maximum value of the intensity became nearly 15 % greater than on the other ascents. This difference is considered real but the reason for it is not yet determined. The observed form of the ionisation curve agrees with the assumption that the primary radiation is electromagnetic. Analysis of the results shows that the radiation in the atmosphere consists of two or three components of different penetrating power. The method with the open ionisation chamber is very convenient for obtaining the whole curve from sea-level to the top of the atmosphere for with it the observed values vary only from 1 to 5 while the ionisation in the closed chamber varies from 1 to 150. J. J. S.

175. Variation in Intensity of Cosmic Rays between the Latitudes 45° N. and 38° S. P. Auger and L. Leprince-Ringuet. *Comptes Rendus,* 197. *pp.* 1242–1244, *Nov.* 20, 1933.—Three sets of 3 Geiger counters were used to register coincidences of cosmic rays on a boat travelling from Havre to Buenos Ayres and back. From the analysis of several hundred thousand coincidences it is concluded that a diminution of about 16 per 100 occurs in going from 40° N. or S. to the equator. If part of the cosmic radiation consists of charged corpuscles the diminution may be attributed to the action of the earth's magnetic field. F. C. C.

176. Distribution of Cosmic Ray Paths in a Vertical Cylinder. W. F. G. Swann. *Frank. Inst., J.* 216. *pp.* 559–581, *Nov.*, 1933.—A discussion and solution is given of the problem of finding $f(l)$ the coefficient of dl in the expression for the number of cosmic rays which travel distances between l and $l + dl$ in a cylinder standing with its axis vertical. The solution is of importance in connection with the detection of individual secondary cosmic rays by measurement of the ionisation which they produce in such a cylinder, and in the interpretation of the results in terms of the ionisation per cm. of path of the rays. [See following Abstract.] J. J. S.

177. Distribution of Cosmic Ray Paths in a Vertical Cylinder. D. L. MacAdam and M. R. Lipman. *Frank. Inst., J.* 216. *pp.* 583–589, *Nov.*, 1933.—A graphical solution is given of the problem, discussed in Swann's paper. [See preceding Abstract.] J. J. S.

See also Abstracts 118, 165, 379, 383.

RADIATION, GENERAL THEORY.

178. Eigen-Forces of Elementary Particles. Part I. G. Wentzel. *Zeits. f. Physik*, 86. 7–8. *pp.* 479–494, *Nov.* 15, 1933.—The Maxwellian field of an elementary particle in the four-dimensional continuum contemplated in the quantum-electrodynamic theory of Dirac, Fock and Podolsky (*Phys. Zeits. d. Sowjetunion*, 1932, 2, 468) is deduced. The field has very different characteristics inside and outside the light cone radiating from the particle. For the classical limiting case ($\hbar = 0$) it is shown that the field at the world-point of the particle can assume finite limiting values. The eigen-force of a non-expanding particle can therefore be so defined that the particle experiences only radiation-damping and not electromagnetic inertial resistance. Calculation of this radiation-damping in accordance with relativistic wave-mechanics introduces difficulties originating in the vibratory motion of the Dirac electron. J. S. G. T.

See also Abstract 350.

RADIATION, MECHANICAL EFFECTS.

179. Experimental Detection of the Einstein Recoil Radiation. R. Frisch. *Zeits. f. Physik*, 86. 1–2. *pp.* 42–48, *Oct.* 17, 1933.—Apparatus is described for the experimental detection of the deflection of a long thin stream of Na atoms when irradiated with resonance light. Results are given for both lateral and edge-wise illumination; in the latter case the effect is very small. W. R. A.

REFLECTION. REFRACTION AND DISPERSION.

180. Molecular Refractivities of Ethylene Chloride, 1, 1, 2, 2,-Tetrachlorethane and their Mixtures. S. Hamai. *Chem. Soc., Japan, Bull.* 8. *pp.* 297–306, *Oct.*, 1933. *In English.*—Refractive indices of ethylene chloride, 1, 1, 2, 2,-tetrachlorethane and their binary mixture have been measured. Variation of the refractive index with respect to temperature and to the molar fractions at 25° C. have been studied. Linear dependence of the refractive index on the reciprocals of absolute temperature in each case was observed. The molar refraction for both ethylene chloride and 1, 1, 2, 2,-tetrachlorethane have been calculated as 20·82 and 31·23 respectively. The electric moment μ has been calculated for liquid ethylene chloride to be $1 \cdot 375 \times 10^{-18}$. AUTHOR.

181. Molecular Refraction in Dilute Solutions. Part II. W. Geffcken and A. Kruis. *Zeits. f. phys. Chem.* 23. *Abt.B.* 3–4. *pp.* 175–192, *Nov.*, 1933.—An interferometer method based on that of Haber-Loewe is described to enable precision measurements of refractive index differences (solution with respect to solvent) with an absolute accuracy of $0 \cdot 0_6 5$ for the most concentrated solutions ($2N$) to about $0 \cdot 0_7 3$ for the most dilute ($< 0 \cdot 1N$). Solutions of NaCl and KCl and of NH_4NO_3 were employed. The results are discussed with respect to the Debye-Hückel theory. [For Part I see Abstract 2398 (1933).] H. H. Ho.

182. Improvements in the Schlieren Method. H. G. Taylor and J. M. Waldram. *Journ. Sci. Instruments,* 10. *pp.* 378–389, *Dec.,* 1933.—The "Schlieren" method is an old but little-known method of rendering visible either colourless fluids, which have a different refractive index from their surrounding medium, or variations of refractive index or thickness of transparent solids. It may thus be used for demonstrating convection currents in air, the movement of gases in air, or inhomogeneities in glass. After an historical survey, the principle of the method is given, followed by a description of the optical arrangements which have previously been used, and the authors' improvements by which double the usual sensitivity and increased ease of adjustment are obtained. The paper concludes with a description of various uses of the method. AUTHORS.

183. Resolving Power of the Microscope with Dark Ground Illumination. G. Stade and H. Wetzlich. *Zeits. f. Physik,* 86. 5–6. *pp.* 373–381, *Nov.* 10, 1933.—The paper discusses the relation between the resolving power of a microscope for self-luminous and non-self-luminous objects and describes experiments that demonstrate the incompleteness of the Abbe theory. Beck's observations on the apertures required to resolve diatoms in light and dark ground illumination are confirmed and discussed. W. D. W.

184. Optical Amplification of Reflecting Galvanometer Deflections. L. Dubar. *R.G.E.* 34. *pp.* 669–676, *Nov.* 18, 1933.—With the conventional arrangement of a mirror galvanometer the reflected ray turns through twice the angle through which the mirror is deflected. The movement of the spot on the scale varies with the distance of the latter from the galvanometer, but the magnification thus obtained is limited by considerations of space and by the decreasing brilliance of the spot. The author's method overcomes these limitations and permits the construction of a compact, portable apparatus suitable for laboratory or industrial use. Under stated conditions, the maximum scale distance, or equivalent amplification consistent with accuracy of reading, allowing for diffraction by the mirror, is f cm. $= 1000a$ or $820D$, where $a =$ the width of the rectangular mirror and $D =$ the diameter of the circular mirror in cm. The size of the mirror and the magnitude of the control force must be adapted to the maximum period consistent with accuracy of reading; formulæ are given for the optimum conditions. Methods of illuminating the spot are considered quantitatively, and the visibility of the image is discussed. With an auxiliary mirror placed near the moving mirror, multiple reflection is obtained, the rotation of the emergent ray is $2n$

times that of the moving mirror and an amplification of *n* is obtained, compared with single reflection. Practical limitations are pointed out. The optical distance between mirror and scale may be increased by multiple reflection between two fixed parallel mirrors; for the same amplification, *n* reflections are required, compared with $(2n - 1)$ in the first method. A convex mirror and a plane mirror are used, giving a sensitivity corresponding to a scale distance of 5 m., the apparatus being contained in a box 0·35 m. long. The length of scale is 0·2 m., the distance from the galvanometer mirror to the primary spot is 0·25 m., and a magnification of 20 is obtained. Notes on the construction and adjustment of the instrument are included. R. E. N.

See also Abstracts 71, 162, 187, 193, 194, 195, 236, 244, 282, 320.

SPECTROSCOPY.

185. Standard Copper Wave-Lengths in the Region 100 Å to 450 Å. P. G. Kruger and F. S. Cooper. *Phys. Rev.* 44. *pp.* 826–830, *Nov.* 15, 1933.—The copper spectrum has been photographed in the region 100 Å to 450 Å with a 21 ft. grazing incidence vacuum spectrograph. The wave-length of sharp copper lines (approximately two every Ångstrom) have been determined by interpolating between known aluminium and oxygen lines with the formula $\lambda = \lambda_0 + Ax + Bx^2 + Cx^3 \cdots$. A discussion of the errors in the wave-lengths is given. AUTHORS.

186. Wave-Lengths of the Red Lines of Neon and their Use as Secondary Standards. C. V. Jackson. *Roy. Soc., Proc.* 143. *pp.* 124–135, *Dec.* 4, 1933.—The wave-lengths of the red lines of neon have been compared with the primary standard, by means of Fabry-Perot interferometers of resolving powers ranging from 70,000 to 800,000. With resolving powers greater than about 250,000, the neon lines have constant wave-lengths, and the values found in this investigation are in almost perfect agreement with those of Burns, Meggers and Merrill. The systematic difference is under 0·0001 Å, while the mean accidental difference is ± 0·0002 Å. With lower resolving powers the apparent wave-lengths of the neon lines become systematically lower until constant values are reached at about 100,000, these being about 2 mÅ. smaller than those found at high resolving powers. This is caused by blending of the weak satellite (due to Ne 22) with the main line. It is shown that the observed changes in apparent wave-length are in good agreement with those calculated from the doublet separations given by Nagaoka. A table of corrections for low resolving power is given. When these corrections are applied, the neon lines form satisfactory secondary standards. The conditions for exciting the lines so that they are accurately reproducible in wave-length and free from self-reversal are given. The restrictions are not very stringent. The wave-lengths of the lines given by the Hilger-G.E.C. neon lamps do not differ from those given under the conditions described above by more than 1 part in about 15 million. If this lamp is used as a source of light, however, the lines 6402 and 6143 should not be used as standards as they appear reversed in some of the lamps. AUTHOR.

187. Fine Structure of Residual Rays. M. Blackman. *Zeits. f. Physik*, 86. 7–8. *pp.* 421–447, *Nov.* 15, 1933.—A one-dimensional theory of damping is worked out for the residual-ray absorption of the alkali halides, followed by a more general three-dimensional theory which differs little from the former but is in better agreement with experimental results. The general theory accounts for the presence of neighbouring absorption maxima in the absorption wave-length curve of the alkali halides and also for the sudden fall in absorption on the short wave-length side of the shorter wave-length absorption maximum. The shape of the observed absorption curves for wave-lengths from 10 to 2000 μ is compared with those calculated from theory and the agreement between them is discussed. [See Abstract 3547 (1933).] H. J. H. S.

188. Series in the Spark Spectrum of Radium, Ra II. E. Rasmussen. *Zeits. f. Physik,* 86. 1–2. *pp.* 24–32, *Oct.* 17, 1933.—The spark spectrum of radium was studied in the range 1880 to 11,000 Å, using as source a carbon hollow kathode containing radium chloride, in a helium atmosphere. A table is given showing the wave-lengths and intensities of 62 lines together with the deduced term derivations. The analysis yielded 36 terms in a term system of alkali type. As in the Ba II spectrum, the deepest D term is metastable, and the F term series shows anomalies. For the ground term the analysis gave $S\,I = 81{,}842 \cdot 31$ cm^{-1}., corresponding to an ionisation potential of 10·099 volts. W. S. S.

189. Spectrum of Doubly Ionised Argon, A III. T. L. de Bruin. *K. Akad. Amsterdam, Proc.* 36. 7. *pp.* 724–729, 1933.—This paper deals with the main terms and multiplets in the A III spectrum. The spectrum was observed " end on " by means of a Hilger E I spectrograph and the various stages of ionisation were separated by means of varying the self-induction in the circuit. It is expected that the spectrum will be similar to that of S I and Cl II which have already been partially analysed. Various multiplets are identified but it is not possible to assign accurate values to the terms. No intercombinations have so far been detected. A. H.

190. New Terms in the Spectra of N III, N IV, N V, O III, O IV, and O V. W. M. Cady. *Phys. Rev.* 44. *pp.* 821–825, *Nov.* 15, 1933.—Certain spectrum plates from a new type of discharge have been analysed. The source was a condensed discharge through air at a pressure of a few microns to a few hundred microns taking place in a quartz tube of about 2 mm. bore and 9 cm. long. From 50 to 500 discharges of a large h.t. condenser sufficed for good exposures between λ105 and 796 Å, and showed known lines of carbon, nitrogen, oxygen and silicon. New lines have been identified, which establish new levels in N V, O IV and O V, and which join for the first time isolated groups of known levels in N III, N IV and O III. AUTHOR.

191. Nuclear Moments of Sodium and Potassium. S. Frisch. *Phys. Zeits. d. Sowjetunion,* 4. 3. *pp.* 557–562, 1933. *In German.*—The nuclear moment of sodium has been determined from the intensity ratios of the hyperfine structure components of the D-lines by several investigators. Since the intensity ratio in a resonance line depends on the current, on account of self-absorption, these determinations have not given consistent results. Hyperfine structure measurements are extended to the $3s^1P_1 - 3p^3S_{0,1,2}$ triplet of the Na II spectrum; the observed contours of these lines are best explained by a value $I = 3/2$ for the nuclear moment of sodium. Hyperfine structure measurements are also made on about 30 lines of the K II spectrum ; all are found to be of single structure and the nuclear magnetic moment of potassium must therefore be very small compared with that of sodium. J. E. K.

192. Magnetic Nuclear Moments of the Rubidium Isotopes. D. A. Jackson. *Zeits. f. Physik*, 86. 1–2. *p.* 131, *Oct.* 17, 1933.—The values of the nuclear moments of rubidium, I = 5/2 for Rb^{85} and I = 3/2 for Rb^{87}, which have been recently deduced by Kopferman, were given with other values as possibilities in a previous paper by the author [see Abstract 2414 (1933)] and may now be regarded as established beyond doubt. Using these values of the nuclear moments and the author's previously given measurements the ratio of the magnetic moments μ^{87}/μ^{85} is equal to 2·0 and the isotope displacement is calculated to be zero instead of the previous value of 0·02 cm^{-1}. J. E. K.

193. Transition Probabilities in the Subsidiary Series of Thallium. A. Filippov and W. Prokofjew. *Zeits. f. Physik*, 85. 9–10. *pp.* 647–660, *Sept.* 30, 1933.—The anomalous dispersion of thallium vapour at temperatures between 600° and 1075° C. has been examined in the region 2200–2060 Å, and particularly in the neighbourhood of the line at 2207 Å. For the first subsidiary series the ratio of the number of dispersion centres of the first two terms is small in comparison with the alkali metals, whilst in both the subsidiary series the number of centres falls off more slowly than in the case of the principal series of the alkali metals. The intensity of the fourth term of the sharp series is about 1·6 times that of the third term, whilst the transition probability is 1·81 times greater. The sharp series could be followed to its limit, but the diffuse series could be observed only as far as the fourth or fifth term. With increase of the principal quantum number the transition probability in the diffuse series falls continuously, whereas in the sharp series the curve passes through a small maximum at $n = 10$. The ratios of the transition probabilities for the first terms of the diffuse and sharp series and for the line at 2210 Å (which does not fall into either series) have been calculated. H. F. G.

194. Transition Probabilities in the Subsidiary Series of Sodium. L. S. Ornstein and J. Key. *Zeits. f. Physik*, 85. 9–10. *pp.* 565–567, *Sept.* 30, 1933.—The results of preliminary measurements with sodium chloride in a carbon arc at 5360° and 4260° Abs. are recorded. H. F. G.

195. Dispersion in Electrically Excited Gases. R. Ladenburg. *Rev. Modern Physics*, 5. *pp.* 243–256, *Oct.*, 1933.—No fresh experimental results are reported in this paper which consists mainly of a presentation of the position as regards dispersion in electrically excited gases. Topics considered are: transition probabilities and lifetime of neon levels; population of excited levels in the positive column, statistical equilibrium between different levels, relation to electron temperature ; influence of higher currents upon the dispersion, effect of negative dispersion ; statistical equilibrium between the *s* and *p* states of neon. A. H.

196. Quantum Mechanics Derivation of the Balmer Terms. L. Hulthén. *Zeits. f. Physik*, 86. 1–2. *pp.* 21–23, *Oct.* 17, 1933.—It is shown that the solution for the energy levels of the hydrogen atom, derived originally by Pauli on the basis of the then new Heisenberg quantum mechanics, can be obtained more directly by the simpler methods of matrix calculation due particularly to Dirac. The matrix equations used by Pauli are reduced to well-known matrix relations occurring in the discussion of angular momentum. W. S. S.

197. Theory of the Broadening of Spectral Lines. H. Margenau. *Zeits. f. Physik*, 86. 7–8. *pp.* 523–529, *Nov.* 15, 1933.—The connection between the intensity distributions of a spectral line, as determined on the one hand by Fourier analysis and on the other hand by statistical analysis of the frequencies, is explained. The displacement, the statistical scattering and the sharpness of the Fourier distribution are calculated for certain stipulated conditions; it is shown that they agree with those of the statistical distribution. J. E. K.

198. Ground State of the Hydrogen Molecule. H. M. James and A. S. Coolidge. *J. Chem. Phys.* 1. *pp.* 825–835, *Dec.*, 1933.—The method used by Hylleraas in treating the He atom has been extended to the H_2 molecule. The method consists of setting up a wave function as a series in the five variables required, electronic separation being introduced explicitly as one of the variables. The coefficients are then determined so as to produce the lowest energy. The energy found is within 0·03 e.V. of the most probable experimental value, while the form and location of the potential energy curve for various internuclear distances agree with those deduced from spectra to within similar limits. The value of the function is computed for several configurations of the electrons, and compared with other approximations. Application of the method to other problems is discussed. A method is given for the numerical solution of secular equations of high degree. AUTHORS.

199. Absorption Spectra of Organic Molecular Compounds. W. H. Hunter and E. H. Northey. *J. Phys. Chem.* 37. *pp.* 875–887, *Oct.*, 1933.—Quantitative measurements of the absorption spectra of chloroquinone, benzoquinone, toluquinone, xyloquinone, and duroquinone are recorded for thin layers of the melted solids in the absence of solvent. The absorptions of equimolecular mixtures of these substances with aromatic hydrocarbons, ethers and amines were also measured, and the effect of these " solvents " on the spectra of the quinones observed. The changes were correlated with the known oxidation-reduction potentials of the quinones. It is concluded that the change in the absorption spectrum brought about by a " solvent " capable of forming molecular compounds increases with increasing oxidation-reduction potential of the quinones, and that the order in which " solvents " fall with respect to increasing effect on the absorption is independent of the quinone studied. C. B. A.

200. First Negative Group of CO^+. H. Biskamp. *Zeits. f. Physik*, 86. 1–2. *pp.* 33–41, *Oct.* 17, 1933.—An intense electron collision tube is described. Using this apparatus and h.f. excitement the band spectrum of CO^+ has been obtained. Twenty-two new bands of the first negative group are recorded, and a new series formula put forward. Potential curves of the $^2\Sigma$, $^2\Sigma^*$ and $^2\Pi$ states are given, the energies of dissociation calculated, and the dissociation products discussed. W. R. A.

201. Second Positive Group of Nitrogen. D. Coster, F. Brons and A. van der Ziel. *Zeits. f. Physik*, 86. 5–6. *pp.* 411–412, *Nov.* 10, 1933.—Corrections to a previous paper [see Abstract 4516 (1933)], principally regarding the energy of dissociation and that of the difference between singlet and triplet states. F. S.

202. Rotation-Vibration Spectrum of Methane. H. Vedder and R. Mecke. *Zeits. f. Physik*, 86. 3–4. *pp.* 137–156, *Oct.* 31, 1933.—The absorption spectrum of methane in column-lengths up to 20 m., and pressures up to 5 atm., has been photographed between 10,000 and 7000 Å. Seven bands, at 9880, 9700, 8900, 8600, 8400, 7800, 7250 Å respectively, have been measured. It was not possible to analyse the complicated rotation structure of the bands, but the 23 bands previously found in the absorption and the three Raman frequencies can now be attributed to the four normal vibrations of the molecule. These are $\nu(a) = 3015 - 15v$; $\nu(s) = 2945 - 50(v_s + v_a)$; $\delta(a) = 1320 - 15(v_a + v_s)$; $\delta(s) = 1530 - 10(v_a + v_s)$. Calculation shows that the requirements of the system of valency forces are satisfied if the C – H, the angular, and the H – H forces are in the ratio 5·5 : 1 : 0·12. C. B. A.

203. Molecular Spectra of Indium and Gallium Halides. A. Petrikaln and J. Hochberg. *Zeits. f. Physik*, 86. 3–4. *pp.* 214–230, *Oct.* 31, 1933.—The ultra-violet emission and absorption spectra of indium chlorides ($InCl_2$ and InCl), indium bromide (InBr), gallium chlorides (GaCl and $GaCl_2$), gallium bromide (GaBr and $GaBr_3$), and gallium iodide (GaI_3) are investigated experimentally. At high temperatures the di- and tri-halides are in equilibrium with the corresponding mono-halides and the corresponding band spectra are all present; higher halides are apparently unstable in the excited state and dissociate, giving continuous spectra. Band spectra of the mono-halides have very approximately the same structure: a short wave system (A) is accompanied by a long wave system (B). In the cases of the spectra of InCl and GaCl, the A-systems were composed of a singlet system which could be resolved into terms. The effect of isotopes was observed. The B-systems of the spectra of all compounds investigated were likewise singlet systems. J. S. G. T.

204. Band Spectrum of Bismuth Oxide. C. Ghosh. *Zeits. f. Physik*, 86. 3–4. *pp.* 241–248, *Oct.* 31, 1933.—The spectrum was produced in a carbon arc, of which one electrode was cored with bismuth metal, and photographed with large quartz and glass spectrographs and a 6-ft. concave grating. Between 4300 and 6700 Å four band systems have been analysed. Two of these systems have a common lower level corresponding to a heat of dissociation of 1·86 volt. F. S.

205. Absorption of Bismuth Vapour. A. Trojecka. *Acta Physica Polonica*, 2. 2. *pp.* 245–252, 1933. *In French.*—142 band heads in the absorption spectrum of bismuth vapour between 4700 and 6500 Å have been photographed and measured. The bands are classified into four groups as follows: $\nu = 15426 + 131{\cdot}9\,(v' + \frac{1}{2}) - 0{\cdot}13\,(v' + \frac{1}{2})^2$; $\nu = 15270 + 129{\cdot}7\,(v' + \frac{1}{2}) - 0{\cdot}055\,(v' + \frac{1}{2})^2$; $\nu = 15010 + 136{\cdot}8\,(v' + \frac{1}{2}) - 0{\cdot}183\,(v' + \frac{1}{2})^2$; $\nu = 19852 + 71\,(v' + \frac{1}{2}) - 0{\cdot}54\,(v' + \frac{1}{2})^2$. The results are compared with those deduced from the fluorescence spectra in the same region. C. B. A.

206. Triplet Band Spectrum of Aluminium Hydride. W. Holst. *Zeits. f. Physik*, 86. 5–6. *pp.* 338–347, *Nov.* 10, 1933.—An analysis is given of a new triplet band of AlH near 3800 Å, obtained with an arc between two aluminium electrodes in an atmosphere of hydrogen at reduced pressure. The band, which resembles the NH band at 3360 Å, corresponds to a $^3\Sigma \rightarrow {}^3\Pi_i$ transition, the $^3\Pi_i$ term following the case *b*. From the intensity distribution in the multiplet components it is shown that this term is inverted. The band exhibits predissociation for $k > 25$, whence the energy of dissociation is calculated to be $D \leqq 0 \cdot 52$ volt. The two terms $^3\Sigma$ and $^3\Pi$ are classified in the term scheme of aluminium hydride. L. A. W.

207. Spectroscopic Detection and Structure of the PN Molecule. J. Curry, L. Herzberg and G. Herzberg. *Zeits. f. Physik*, 86. 5–6. *pp.* 348–366, *Nov.* 10, 1933.—Using a discharge through nitrogen in presence of phosphorus vapour, a new band system is found between 2400 and 2900 Å. Spectrograms are reproduced. The band is regarded as belonging to the molecule PN, which has not previously been detected. An analysis of the band, which corresponds to a $^1\Pi \rightarrow {}^1\Sigma$ transition, is carried out and the molecular constants calculated. In conclusion a comparison is made with the molecules CS, SiO, N_2 and P_2, in which it is noted that the PN molecule shows a greater similarity to N_2 than to P_2. L. A. W.

208. λ 3240 Band of NH. R. W. B. Pearse. *Roy. Soc., Proc.* 143. *pp.* 112–123, *Dec.* 4, 1933.—A band at λ 3240 was observed near the λ 3360 band of NH in the spectrum of a heavy-current discharge tube containing nitrogen and hydrogen. Its occurrence in other sources containing nitrogen and hydrogen was investigated. It is also attributed to NH. The band was photographed under high dispersion. Analysis showed that the band possessed the intensity distribution and number of "missing lines" characteristic of a $^1\Pi \rightarrow {}^1\Delta$ transition. The narrow doubling occurring in each of the P, Q and R branches is attributed to Λ-doubling of the $^1\Pi$-levels. The rotational term differences are obtained and values of the rotational constants calculated. The relation of the electronic levels of the molecule NH to the lowest levels of the atom N is discussed. A catalogue of wave-lengths is given. AUTHOR.

209. Band Spectrum of Barium Oxide. P. C. Mahanti. *Phys. Soc., Proc.* 46. *pp.* 51–61, *Jan.* 1, 1934.—New measurements of the bands of barium oxide have been made from moderate-dispersion and high-dispersion spectrograms. The band-head data of the early investigations have been extended in the red region as far as λ 8000. The bands lying between λ 8000–λ 4300 have been assigned to a single system. The equation representing the wave-numbers of band-heads is :—

$$\nu = 16815 \cdot 89 + \{495 \cdot 36\,(v' + \tfrac{1}{2}) - 1 \cdot 12\,(v' + \tfrac{1}{2})^2\} - \{671 \cdot 48\,(v'' + \tfrac{1}{2}) - 2 \cdot 20\,(v'' + \tfrac{1}{2})^2\}.$$

The bands (0, 3), (0, 2), (1, 2), (1, 1) and (2, 1) have been analysed. Their rotational structure reveals that the band system is due to a $^1\Sigma \rightarrow {}^1\Sigma$ transition. The following rotational constants have been evaluated :—

$B_e' = 0 \cdot 30995$ cm.$^{-1}$ $\beta' = 0 \cdot 24 \times 10^{-9}$ $B_e'' = 0 \cdot 36440$ cm.$^{-1}$ $\beta'' = -1 \cdot 2 \times 10^{-9}$
$\alpha' = 0 \cdot 0011$ $r_e' = 1 \cdot 938 \times 10^{-8}$ cm. $\alpha'' = 0 \cdot 0016$ $r_e'' = 1 \cdot 787 \times 10^{-8}$ cm.
$D_e' = -0 \cdot 483 \times 10^{-6}$ $I_e' = 89 \cdot 44 \times 10^{-40}$ gm.cm.^{2} $D_e'' = -0 \cdot 430 \times 10^{-6}$ $I_e'' = 76 \cdot 04 \times 10^{-40}$ gm.cm.^{2}

AUTHOR.

210. Proton Spin and Hyperfine Structures in Band Spectra. S. Mrozowski. *Acta Physica Polonica*, 2. 2. *pp.* 235–237, 1933. *In German.*—A number of lines of the 3064 Å band of the OH-molecule are investigated with a quartz Lummer-Gehrcke plate and a quartz spectrograph. A resolving power of about 400,000 is thus obtained, but no separation of the lines into components is noticeable. It is therefore concluded that if proton spin is responsible for a further subdivision of a band line into components the separation of the latter cannot be greater than 0·07 cm.$^{-1}$ The suggestion made by the author in a previous paper [see Abstract 1241 (1932)] that the complex structure of the HgH band lines was caused by proton spin must be withdrawn since the separations of the HgH band line components are about 0·1 cm.$^{-1}$ The normal isotope effect is probably responsible for the separations in the HgH band as suggested previously by Hulthén. J. E. K.

211. Fluorescence Spectrum of Hypericine and Mycoporphyrine. C. Dhéré. *Comptes Rendus*, 197. *pp.* 948–950, *Oct.* 23, 1933.—Hypericine and mycoporphyrine are extracted from widely different plants. Yet these pigments have been thought from their remarkable absorption and fluorescence, to be, possibly, the same substance. A detailed study of the fluorescence spectrum has now shown that this is the case. J. E.

212. Zeeman Effect and Uncoupling Phenomena in the CaH Bands. W. P. Cunningham and W. W. Watson. *Phys. Rev.* 44. *pp.* 815–817, *Nov.* 15, 1933.—The effect of the strong *l*-uncoupling in the $^2\Pi$ state on the Zeeman patterns of the lines of the $^2\Pi \rightarrow {}^2\Sigma$ CaH band at 7000 Å is discussed. AUTHORS.

213. Stark Effect in Variable Fields. D. Blochinzew. *Phys. Zeits. d. Sowjetunion*, 4. 3. *pp.* 501–515, 1933. *In German.*—A theoretical discussion is given of the action of a harmonic electric field on the radiation of the atom with various frequencies of the field. A continuous transition from the Stark effect to dispersion is established. The possibility of the experimental proof of the theory is discussed. J. J. S.

214. Raman Effect and Electrolytic Dissociation of Sulphuric Acid. I. R. Rao. *Indian Journ. Phys.* 8. *pp.* 123–135, *Oct.* 7, 1933.—An account is given of a study of the changes in the Raman effect of sulphuric acid on dilution, spectrograms and photometer curves being reproduced for five different acid concentrations ranging from the pure acid to 2*N*. Owing to the presence of a continuous background in the spectra, the results are only qualitative in character. The observed intensity changes of the lines, which are similar to those found by previous workers [see Abstract 1798 (1932)], are discussed in relation to the electrolytic dissociation and the structure of sulphuric acid. L. A. W.

215. Raman Effect in Aluminium Salts. A. de Silveira. *Comptes Rendus*, 197. *pp.* 1035–1037, *Nov.* 6, 1933.—With the sulphate and nitrate of aluminium in solutions, apart from bands attributed to the NO_3 and SO_4 ions and to water, there is obtained a band similar to one obtained with Mg salts but triple instead of continuous giving $\Delta\nu =$ 396, 552 and 656 cm.$^{-1}$ The 396 frequency is attributed to Al^{+++}. A frequency 1530 cm.$^{-1}$ is considered as possibly due to hydrolysis of Al ion. J. E.

216. Discovery of the Molecular Diffusion of Light in Pure Liquids. A. Turpain. *Comptes Rendus*, 197. *pp.* 1107–1109, *Nov.* 13, 1933.—A note on the experiments of Lallemand published in 1869 and following years, in which he describes the effects of light in pure liquids. Lallemand was the first who established experimentally that no media optically void exist. He showed that there is a reflection by the molecules of pure liquid, and foresaw part of the Raman effect. J. J. S.

217. Complete Raman Spectrum of Benzene between 4100 and 5100 A. P. Grassmann and J. Weiler. *Zeits. f. Physik*, 86. 5–6. *pp.* 321–337, *Nov.* 10, 1933.—Using unfiltered Hg-excitation the

Raman spectrum of liquid benzene is photographed between 4100 and 5100 Å by means of a spectrograph of high resolving power (40,000). Analysis reveals 41 Raman frequencies, 18 of which are new. Except for marked intensity differences, there exists a complete analogy between Raman spectrum and infra-red absorption spectrum. Most of the Raman frequencies can be interpreted as simple combinations of 10 fundamental frequencies. New arguments are put forward in favour of the view that the Raman frequency 984 cm.$^{-1}$, which appears as a weak companion of the frequency 992·5, is due to a carbon isotope 13. L. A. W.

218. Vacuum Spectrograph. W. Tschulanowsky. *Phys. Zeits. d. Sowjetunion,* 4. 3. *pp.* 443–458, 1933. *In German.*—A 1-m. concave grating vacuum spectrograph is described in which the usual eagle arrangement is used. A number of points of design found in practice have been introduced. It is claimed that the work of the experimenter is lightened and that the resolving power of the grating is used to better advantage. F. S.

219. Spectrum Interval Sorter. G. R. Harrison. *Rev. Sci. Instruments,* 4. *pp.* 581–586, *Nov.,* 1933.—The sorter recently described [see Abstract 1519 (1933)] has been modified to increase its accuracy and convenience. It now applies the combination principle to selected group of lives and in the present form intervals up to 10,000 wave-numbers can be recorded with an accuracy of ± 0·02 wave-number. Round holes are punched at regular intervals to give fiducial marks and make tape stretch evident at a glance. Electric motor drives and mercury arc illumination increase speed of working and flexibility. It has been applied to the spectra of osmium, iridium and cerium, and has shown the need for more accurate wave-length measurements for the rare earths. F. S.

220. Symmetrically-Opening Optical Slit. J. E. Sears. *Journ. Sci. Instruments,* 10. *pp.* 376–377, *Dec.,* 1933.—The paper describes a new type of symmetrically-opening slit for use with spectrometers and similar apparatus. The results of test show that up to a slit width of 1 mm. the displacement of the centre line of the slit does not exceed 1 per cent of the opening. Narrow slit openings can be set and repeated with precision. AUTHOR.

221. Improvements in the 21-Foot Normal Incidence Vacuum Spectrograph. G. R. Harrison. *Rev. Sci. Instruments,* 4. *pp.* 651–655, *Dec.,* 1933.—The 21-ft. normal incidence vacuum spectrograph previously described by the writer [see Abstract 810 (1932)] has been improved by the provision of 30,000 lines per inch glass and speculum gratings in addition to the 15,000 lines per inch grating previously used, and by the installation of a simpler and much more rapid pumping system. The range has been extended so that the instrument can be used from 6000 to 300 Å, and orders up to and including the sixth have been photographed, giving dispersions ranging between 2·72 Å/mm. and 0·22 Å/mm. with the advantages of an almost normal spectrum. When a constant value for the dispersion is used over a 16-inch plate the correction factor seldom exceeds 0·3 Å. The errors introduced when Rowland's method of coincidences is used with these Wood gratings appear to be much less than 0·01 Å. Wave-lengths of numerous lines of the hot-spark spectra of copper and nickel, and of the h.f. discharge spectra of argon and neon, have been measured with the instrument, and the accuracy of many of the measurements appears to be $\pm 0{\cdot}005$ Å. The resolving power thus far attained, while still below the theoretical limit of the gratings, is far above that previously claimed for this region. A single steel oil-condensation pump of 8″ internal diameter is used, together with a trap in which either solid CO_2 or circulating tap water can be used as refrigerant. A vacuum of about 2×10^{-4} mm. is found sufficient to photograph the complete spectrum covered by the instrument without appreciable absorption in the optical path of 42 feet; a higher vacuum can be obtained in the tube quite readily. AUTHOR.

222. Calculation of Free Energies, Entropies, Specific Heats and Equilibria from Spectroscopic Data: Validity of the Nernst Heat Theorem. H. Zeise. *Zeits. f. Elektrochem.* 39. *pp.* 758–773, *Sept., and pp.* 895–909, *Nov.*, 1933.—In the first part a general review of the subject is given consisting of a concise presentation of the most important of the relevant relationships from thermodynamics, statistics and spectroscopic theory, together with an account of their application to monatomic, diatomic, triatomic and polyatomic molecules. In the second part some examples are considered in order to show the application and practical value of the relationships under review. The cases selected include diatomic molecules with $^1\Sigma$, $^2\Sigma$, $^3\Sigma$ or $^2\Pi$ ground states, linear and non-linear triatomic molecules, and polyatomic molecules of the tetrahedron, pyramid, double pyramid and ring types. The conclusion is reached that the Nernst heat theorem is of general validity and is to be regarded as the third law of thermodynamics. The values of thermodynamic functions calculated from spectroscopic data are regarded as thoroughly dependable, and the available approximate formulæ as sufficient for all practical purposes. L. A. W.

223. Experimental Test of the Principle of Conservation of Spin in Atomic Collision. R. Döpel and K. Gailer. *Phys. Zeits.* 34. *pp.* 827–831, *Nov.* 15, 1933.—Direct test of the principle of conservation of electron spin is not possible by means of electron impact owing to exchange processes. An account is given of a test by the more promising method of atomic impact, mercury vapour being excited by the action of canal rays of helium. Control experiments give the extent of excitation by secondary electrons and show that the He atoms are not appreciably ionised in passing through the Hg vapour. The result obtained is that the impacts of the He atoms with the Hg atoms cause triplet excitation of the latter without any simultaneous triplet emission by the He atoms. The authors regard this as disproving the principle of spin conservation; but an added note gives the opinion of F. Hund, expressed in the discussion, that the application of the principle to electronic transitions due to impact can probably have little, if any, significance. L. A. W.

224. Experimental Test of the Quantum Theory of the Natural Breadth of Spectrum Lines. W. Schütz. *Phys. Zeits.* 34. *pp.* 831–833, *Nov.* 15, 1933.—After a short account of the differences between the theoretical predictions as to the natural breadth of spectrum lines according to the classical theory and the quantum theory in its older and newer forms, a preliminary account is given of the results of an investigation by H. Schillbach (to be published in full shortly) of certain emission lines in the visible spectrum of neon due to transitions from a common upper energy level to lower states with different life periods. Dirac's theory is verified by the experimental result that the natural line breadth of the transitions to the unstable $^3P_1$ term has a value $1 \cdot 1 \times 10^9$ sec^{-1}., which is $0 \cdot 8 \times 10^9$ sec^{-1}. greater than that of the other lines. L. A. W.

225. Quenching of Light from Flames Produced by Various Chemicals. C. D. Child. *Phil. Mag.* 16. *pp.* 1141–1150, *Dec.*, 1933.—When certain chemicals are added to solutions of Ca, Sr, Na, and K salts which are being sprayed into non-luminous flames the amount of light is in general diminished ; in a few cases it is increased. With Ca and Sr salts the amount of quenching varies greatly with the nature of the compound added ; with sodium and potassium the quenching is nearly the same in all cases. These effects can be explained by assuming that the molecules are broken apart in the flame into atoms or groups of atoms which are continually dissociating and recombining. Apparently the equilibrium law holds when dissociation occurs in the flame. AUTHOR.

See also Abstracts 89, 90, 143, 158, 159, 372, 379.

VISION.

226. Photoelectric Visibility Measurements. Part III. L. W. Pollak and W. Gerlich. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 244–267, 1933.—The effects on the eye and cells of different kinds of materials which cause scattering of light are investigated. Methods of making step and circular wedges of such materials are discussed in relation to the kind and colour of the light falling on them, and the relative position of the wedge and the photoelectric cell. It is known that if the same instrument is used in the measurement of visibility in summer and winter the intensity and diffusion of the light are so different that quite different characteristics of the wedges are brought into play. Taking everything into consideration, a visibility measurer has been made which is comparatively correct. [For Part II see Abstract 1090 (1933).] H. M. B.

227. Colour Vision and its Anomalies. Polack. *Comptes Rendus*, 197. *pp.* 1003–1005, *Oct.* 30, 1933.—In an earlier paper [see Abstract 1177 (1932)] Daltonism is examined in regard to the various colour theories. The examination is now extended to other defects of colour vision and the following conclusions drawn : (1) the tri-chromatic theory does not agree with facts ; (2) the terminology should be replaced and the orientation of the point of view modified ; (3) colour-vision is characterised by two factors, the position of maximum luminosity and the extent of unitonal regions ; (4) in anomalous cases one or both of the conditions mentioned in (3) may be modified as is shown in the Dalton and other types of colour vision. H. M. B.

228. Magnitude of the Image of a Near Object for Different Static Conditions of Refraction for Subjects with and without Corrective Glasses. E. Haas. *Rev. d' Optique*, 12. *pp.* 337–362, *Sept.*, 1933.—The use of a corrective glass for vision of near objects is accompanied by a magnification of the object as seen by the subject. The magnitude of this effect, which will depend on the optical constants and the position with respect to the eye of the corrective glass, is computed for the different types of refractive error. Application is made to the problem of image distortion of a corrected astigmat, and to the question of magnification of ophthalmoscopic images. W. S. S.

V. 19

229. Underwater Vision. R. E. Cornish. *J.O.S.A.* 23. *p.* 430, *Dec.*, 1933.—It is found that suitably designed lenses make possible excellent underwater vision for the otherwise naked eye. AUTHOR.

X-RAYS.

230. Stabilising of Cold-Kathode X-Ray Tubes. I. Fankuchen. *Rev. Sci. Instruments*, 4. *pp.* 593–594, *Nov.*, 1933.—The accepted instability of an X-ray tube of the gas type is stated to be due in part to the sporadic emission of occluded gas from various parts of the tube, and in part to variations in the distribution of the electrical lines of force. This latter factor can be reduced by suitable design. If the distance between electrodes is less than the mean free path of the molecules at the pressure in the tube, there is little ionisation and practically no discharge. Making use of this property, a stable type of gas X-ray tube is described in which the kathode is of considerable size, nearly as great in diameter as the glass envelope of the tube, and is located within a metal discharge chamber. The target proper is at some distance from the kathode, but other parts of the anode system are brought very near. The tube may be operated at 20–45 kV, passing a current of 35 mA. G. E. B.

231. Measurement of X-Ray Tube Current and Voltage. G. W. C. Kaye and G. E. Bell. *I.E.E., J.* 73. *pp.* 457–468; *Disc.*, 468–472, *Nov.*, 1933.—Deals mainly with an investigation into the dependence of the output of an X-ray tube on the exciting peak voltage and the tube current. In the case of a hot kathode tube the output (measured by ionisation or photographic methds) was found to be proportional to the current and to some power (n) of the peak voltage. Over the voltage range 65 to 150 kV n is found to vary from nearly unity for unfiltered radiation to 4 or 5 for heavily filtered radiation. The influence of the wave-form of the exciting voltage on the output is investigated, and it is shown that, under similar conditions of peak voltage and milliammeter readings, the output of a tube excited by a constant voltage generator is about 1·8 times as great as that of the same tube excited by a full or half wave pulsating voltage generator. The various methods of measuring voltage are summarised, and it is shown that for the measurement of tube current a moving coil milliammeter is suitable for sustained currents, but for currents of less than about 1 second duration, some form of ballistic meter is preferable. In the *Discussion* **K. Edgcumbe** suggested that r.m.s. voltages would be as useful as peak voltages and easier to measure, and **F. E. J. Ockenden** mentioned other forms of measuring instruments, including a voltmeter operated by a thyratron and a ballistic milliampere-seconds meter, **C. G. Osment** claimed that X-ray output could only be satisfactorily measured by ionisation measurements. **B. Leggett** and **G. G. Blake** pointed out that, from the medical point of view, accurate current and voltage measurements were rarely needed. **A. G. Warren** pointed out that, after filtration through several inches of steel, the X-ray intensity depends on the 10th or 20th power of the tube voltage. G. E. B.

232. Ring-Target X-Ray Generator Adapted to Scattering, Fluorescence and Irradiation Experiments. P. Kirkpatrick and P. A. Ross. *Rev. Sci. Instruments*, 4. *pp.* 645–648, *Dec.*, 1933.—An X-ray generator is described which is especially adapted to the production of strong scattered and fluorescent X-rays. Geometrical conditions are well suited to the study of spectra of scattered radiation. The essential novelty of the apparatus is a ring-shaped target 3 in. in diameter. Sample spectra are presented. AUTHORS.

233. Cu-Kα-Radiation in Argon. G. Herzog. *Helv. Phys. Acta,* 6. 7. *pp.* 508–554, 1933. *In German.*—The ratio of the scattered energy to the incident is $2 \cdot 88 \times 10^{-7} \pm 5$ %, as against a calculated theoretical ratio of $2 \cdot 87 \times 10^{-7} \pm 6$ %. A. D.

234. Changes in the X-Ray Diffraction Pattern of Nitrobenzene Produced by an Electric Field, Changes in Temperature and Circulation. F. C. Todd. *Phys. Rev.* 44. *pp.* 787–793, *Nov.* 15, 1933. —Comparable diffraction patterns of benzene and nitrobenzene were taken with Mo K radiation. Two balanced, krypton-filled ionisation chambers were arranged to read the difference in the ionisation current produced by the X-rays diffracted at the same angle from two similar scattering samples. By their use, the change in the intensity of the nitrobenzene diffraction pattern due to a field of 10 kV per cm. was found to be less than 0·3 % over the entire principal peak. An average of 35 readings on the peak gave a change in intensity of $-0 \cdot 02 \pm 0 \cdot 06$ %. These chambers were also used to measure the change in intensity of the diffraction pattern produced by (1) an increase in temperature from 16° C. to 26° C., (2) an increase in temperature from 30° C. to 42° C., and (3) circulating the nitrobenzene past the point of illumination with X-rays at a velocity of 0·4 cm. per sec. These results were found to be in general agreement with the assumption that the nitrobenzene molecules associate in pairs and are dissociated by thermal or mechanical agitation. AUTHOR.

235. Diffuse Scattering of X-Rays from Sodium Fluoride at the Temperature of Liquid Air. G. E. M. Jauncey and P. S. Williams. *Phys. Rev.* 44. *pp.* 794–797, *Nov.* 15, 1933.—The ratio of the intensity of X-rays diffusely scattered by a single crystal of NaF at 86° K. to that of X-rays scattered by the crystal at 295° K. has been determined at each of several angles ranging from 10° to 42°. The X-rays consisted of a continuous band of wave-lengths, of which the spectral distribution of intensity was known. From Shonka's value of 442° K. for the characteristic temperature of NaF together with his f values for zero point energy, we have calculated the theoretical ratios for different angles. The experimental and theoretical ratios agree very well. The importance of being sure of the absence of Laue spots in this type of experiment is discussed. The experiment was performed by fixing the scattering angle ϕ and varying the crystal angle θ as in the original method of Jauncey and May. If θ is kept constant and ϕ varied there is no sure criterion for the absence of Laue spots. A formula for the ratio at zero scattering angle is given and at small angles the experimental ratio should approach this value. Curves showing the contrast in behaviour of the Laue, diffuse and " total " [see Abstract 4135 (1933)] scattering from NaF and KCl with change of temperature from 295° K. to 86° K. are given. AUTHORS.

236. X-Ray Diffraction of Vitreous Silica. B. E. Warren. *Zeits. f. Krist.* 86. *pp.* 349–358, *Nov.*, 1933. *In English.*—X-ray diffraction patterns of vitreous silica and pyrex glass each show a strong but broad diffraction ring at a scattering angle corresponding to a value " d " in the

Bragg Law of 4·32 Å for silica and 4·26 Å for pyrex. Two methods of interpretation suggest themselves : (*a*) the diffuse ring is due to extremely small crystals of cristobalite, (*b*) due to scattering from a non-crystalline random network. On the first hypothesis the observed ring is the strong (111) reflection from cristobalite crystals about 15 Å in size. A number of objections, particularly those having to do with the width of the ring in connection with heat treatment, seem to rule out the crystallite hypothesis. On the random network hypothesis, it is postulated that the atoms are bound together in the same way as in the crystalline forms of SiO_2, but forming a continuous non-crystalline network. Each Si is tetrahedrally surrounded by 4 O-atoms, and each O shared between two tetrahedral groups. Each tetrahedral group has 4 nearest neighbours at 3·1 Å, and 12 next nearest neighbours at 5·0 Å. Beyond this the distances are indefinite. An expression for the intensity of scattering from such an array leads to an intensity curve in satisfactory agreement with the experimental curve. The random network picture of the vitreous state, deduced from X-ray diffraction study, is in complete agreement with the conclusions reached by Zachariasen from consideration of the chemical and physical properties of glass. AUTHOR.

237. Photographic Action of Ultra-Soft X-Rays. M. Renninger. *Zeits. f. Physik,* 86. 5–6. *pp.* 382–386, *Nov.* 10, 1933.—A photographic effect is described in which the value of the width of the C-Kα line is found to increase in a reproducible manner as the maximum density increases. W. D. W.

238. Satellites of the K-β_1 Line of Potassium. H. Tazaki. *Hiroshima Journ. Sci.* 3. *pp.* 321–325; *Oct.,* 1933. *In English.*—With the aid of a Siegbahn vacuum spectrograph the positions of the satellites of the K-β_1 line of potassium are determined for metallic potassium and some of its compounds. The state of chemical combination appears to affect the number of satellites observed. J. T.

239. Non-Relativistic Theory of the Continuous X-Ray Spectrum. F. Sauter. *Ann. d. Physik,* 18. 5. *pp.* 486–496, *Nov.,* 1933.—A method is given for dealing with the mathematics of the production of " white " X-rays. The problem is treated from the point of view of wave-mechanics and the method is applied to the case of any given potential field, to that of a Coulomb field and to that of a screened Coulomb field. J. T.

See also Abstracts 308, 353.

HEAT.

CALORIMETRY.

240. Heat Capacities of Gaseous Mono- and Di-methylamine. W. A. Felsing and F. W. Jessen. *Am. Chem. Soc., J.* 55. *pp.* 4418–4422, *Nov.,* 1933.—The heat capacities have been measured between 0 to 50°, and the ratio of the heat capacities determined for these substances and for mono-ethylamine. A. S. C. L.

241. Free Rotation in the Lattice of Monosilane. K. Clusius. *Zeits. f. phys. Chem.* 23. *Abt.B.* 3–4. *pp.* 213–225, *Nov.,* 1933.—The specific heat of monosilane, SiH_4, rises steadily from 0·759 at 11·3° Abs. to about 8·48 at 50° Abs., after which a steeper rise occurs to 16·5 at 63·4° Abs.; it then falls sharply and later gradually increases up to the melting point, 88·5° Abs. The specific heat of the liquid shows only a slight increase as the temperature rises to the boiling point. Thus, at 63·4° Abs. solid monosilane undergoes a transformation which is undoubtedly connected with the rotation in the lattice. Optical examination reveals double refraction which is slight below the melting point and marked below the transformation point. A qualitative significance of the unsymmetrical curves expressing the rotation-transformation is revealed by consideration of the strong coupling of the rotations with one another. T. H. P.

242. Internal Heat of Rotation of Ethane. A. Eucken and K. Weigert. *Zeits. f. phys. Chem.* 23. *Abt.B.* 3–4. *pp.* 265–280, *Nov.,* 1933.—The molecular heat of ethane has been evaluated by relative measurements of the thermal conductivity with respect to ethylene [see Abstract 2465 (1933)] up to 140° K. The determination could be so accurately carried out, that it was possible to establish the temperature course of that part of the molecular heat due to the restricted rotation of the two methyl groups with respect to each other (*i.e.,* the so-called internal heat of rotation) with some certainty, and therefrom to determine (as a measure of the restriction) the fall of the potential with an error of ± 20 %. Full experimental details are included. H. H. Ho.

243. Low-Temperature Calorimeter. J. C. Southard and F. G. Brickwedde. *Am. Chem. Soc., J.* 55. *pp.* 4378–4384, *Nov.,* 1933.—An improved adiabatic calorimeter for the measurement of specific heats of liquids and solids between 14 and 300° K. has been constructed. It can be used with a precision of about 0·1 % and is particularly suited to the study of slow transitions and thermal changes. The molal heat capacity of naphthalene was determined between 14 and 300° K. and the entropy and free energy of formation at 298·16° K. calculated to be 39·89 ± 0·12 e. u. and + 48·5 k. cal., respectively. AUTHORS.

CONVECTION.

See Abstract 182.

DILATATION.

244. Transformation Point and Softening of Glasses. E. Rencker. *Comptes Rendus*, 197. *pp.* 1049–1051, *Nov.* 6, 1933.—Measurements on the differential expansion of four different glasses have been made and curves are given. W. D. W.

MELTING AND BOILING POINTS.

245. Freezing Points of Aqueous Solutions. Part IV. Potassium, Sodium and Lithium Chlorides and Bromides. G. Scatchard and S. S. Prentiss. *Am. Chem. Soc., J.* 55. *pp.* 4355–4362, *Nov.*, 1933. —The measurements here detailed were made in order to give a comparison between those made earlier and others to be made later. As in the earlier, less precise measurements, the bromides all show greater deviations from the limiting law than the corresponding chlorides, and the deviations for salts of the same anion increase in the order : K, Na, Li, with the exception of very dilute solutions of LiCl. The most probable curve obtained for this salt appears to cross the curves for NaCl and KCl and the limiting law, but the intersections are all where the curves lie close together and the accuracy is not great. Potassium, sodium, and lithium nitrates, chlorides, and bromides, corresponding with the three ammonium salts which showed well-marked positive deviations from the theoretical limiting law, have also been examined. Eight of these salts showed no positive deviation, and that of LiCl is less than one-tenth of that of the ammonium salts. The behaviour of the latter is still unexplained, but it is certainly not due to a systematic error in measurement. [See Abstract 4415 (1932).] T. H. P.

246. Steady State in a Rectifying Column. W. H. Keesom and H. van Dijk. *K. Onnes Lab. Leiden, Comm. Nos.* 217–228. *Suppt. No.* 71*c. pp.* 34–41, 1933. *In French.*—The time which elapses before the distillation processes in a rectifying column have progressed to a given degree toward the steady state, is calculated in general terms. J. P. A.

247. Graphical Representation of the Process of Rectification. W. H. Keesom. *K. Onnes Lab. Leiden, Comm. Nos.* 217–228. *Suppt. No.* 72*a. pp.* 1–25, 1933. *In French.*—A graphical method, which employs the projections of a W, S, x (W=enthalpy, S=entropy, x=composition) surface, is developed to study the thermodynamics of the process of rectification of binary mixtures. The projection W, x serves to determine the compositions at various stages of the process, whilst the projection W, S gives the energy consumed. [See following Abstract.] R. W. P.

248. Graphical Construction of the W,S,x Surface for Mixtures of Oxygen and Nitrogen at a Pressure of One Atmosphere. W. H. Keesom and W. Tuyn. *K. Onnes Lab. Leiden, Comm. Nos.* 217–228. *Suppt. No.* 72*b. pp.* 26–39, 1933. *In French.*—Using data obtained by earlier investigators the W,S,x surface referred to [see preceding Abstract] has been constructed for mixtures of oxygen and nitrogen at a pressure of one atmosphere. This surface can be used to study the rectification of air. [See following Abstract.] R. W. P.

249. Provisional Construction of the W,S,x Surface for Mixtures of Oxygen and Nitrogen at a Pressure of 5 Atmospheres. W. H. Keesom and W. Tuyn. *K. Onnes Lab. Leiden, Comm. Nos.* 217–228. *Suppt. No.* 72*c. pp.* 40–50, 1933. *In French.*—In order to study the

process of rectification of air at the high pressures developed in the Linde and the Claude types of apparatus, a provisional construction has been given for the W,S,x surface for mixtures of oxygen and nitrogen subjected to pressure of five atmospheres. [See preceding and following Abstracts.]
R. W. P.

250. Graphical Representation of the Process of Decomposition of Air in the Linde Apparatus. W. H. Keesom. *K. Onnes Lab. Leiden, Comm. Nos.* 217–228. *Suppt. No.* 72*d. pp.* 51–63, 1933. *In French.*—Diagrams are given to illustrate the processes which occur in the one and two column types of Linde apparatus for the separation of air. [See preceding Abstract.] R. W. P.

251. Theoretical Comparison of Petroleum Distillation Systems. P. Meyer. *Inst. Petroleum Technologists, J.* 19. *pp.* 819–834, *Oct.*, 1933.—The degree of separation obtainable on distilling a 0–400° C. straight-line boiling mixture into 50 % overhead and 50 % residue is calculated, the method of calculation used being checked by means of published results on equilibrium flash evaporation. The feasibility of comparing the relative efficiencies of various distillation systems by means of an " overlap coefficient " is discussed, and the following tentative conclusions are reached. The amount of material in a petroleum mixture boiling outside the observable boiling range of overlap-underlap affects neither the volume of the overlap or underlap nor the degree of separation obtainable by distillation. Numerical expression of the degree of fractionation is found possible, and selection of the economic compromise between the reflux ratio and the number of plates is thus facilitated. The more plates a distilling column has, the higher is the reflux ratio necessary to make full use of the plates. At high reflux ratio, batch distillation gives sharper cutting than continuous distillation, the number of plates being the same in the two cases. At commercially practicable reflux ratios, however, continuous distillation shows a marked advantage. Continuous distillation cannot be accurately simulated by batch distillation. T. H. P.

252. Nucleus Formation of Condensed Vapour in Unionised Dust-Free Air. Part II. Methyl Alcohol-Water System. J. A. Froemke, C. R. Bloomquist and E. X. Anderson. *Zeits. f. phys. Chem.* 166. *Abt. A.* 3–4. *pp.* 305–315, 1933.—The condensation phenomena of a series of MeOH-water mixtures in dust-free air are examined for adiabatic expansion, and the value of the cloud and deposition (rain) points determined as a function of the concentration or composition of the mixtures. The condensation curves are shown as analogous to those which portray the mobility and volume concentration as a function of the alcohol concentration in the mixture. The easiest condensible vapour is that from a mixture containing three moles of methyl alcohol to one mole of water. The fact that a mixture is more easily condensible than its pure components is explained by means of a " coalescence " theory. [See Abstract 702 (1930).] S. G. B.

253. Liquid-Vapour Equilibria in the Systems Ethanol-Water, Methanol-Water, and Acetic Acid-Water. L. W. Cornell and R. E. Montonna. *Indust. & Engin. Chem.* 25. *pp.* 1331–1335, *Dec.*, 1933. —The method of Rosanoff, Bacon, and White has been used for the determination, at atmospheric pressure, of the liquid-vapour equilibrium curves of the systems ethanol-water, methanol-water, and acetic acid-water.

This method is shown to be consistent and reliable. The equilibrium data obtained by it are compared graphically with all other data found in the literature. AUTHORS.

254. Evaporation of Small Water Drops. H. G. Houghton. *Physics*, 4. *pp.* 419–424, *Dec.*, 1933.—A theoretical expression for the evaporation of small spherical water drops in still air is developed from the general evaporation equation of Jeffreys. Experimental data for the evaporation of drops ranging from 25 to 2600 μ in diameter are obtained at several temperatures and relative humidities. After making approximate corrections for the cooling of the drops it is found that the results are in general agreement with the theoretical evaporation equation. Residual variations which are functions of the drop size and the difference between the water vapour density at the surface of the drop and at a distance from the drop are probably due to inaccuracies in the method used for computing the drop temperatures. The results of the paper furnish a means for computing the total time required for the complete evaporation of a drop of liquid water into a still atmosphere at any given temperature and relative humidity. AUTHOR.

255. Rate of Sublimation. S. Miyamoto. *Chem. Soc., Japan, Bull.* 8. *pp.* 326–331, *Oct.*, 1933. *In English.*—On assumptions similar to those for the rate of solution of solid into liquid [see Abstract 70 (1934)] and with similar (*mutatis mutandis*) meanings for the symbols the rate of sublimation is $S\left(aN_0 e^{-N\epsilon_0/RT}/N - pe^{Mu^2_0/2RT}/\sqrt{2\pi MRT}\right)$, where a is the "accommodation coefficient," *i.e.*, the fraction of the molecules which condense on striking, and p the partial pressure of the sublimed substance in the gas phase. The vapour pressure of the solid is $\sqrt{2\pi MRT}.aN_0 e^{-(N\epsilon_0 - Mu_0^2/2)/N}$. C. A. S.

See also Abstracts 46, 244.

TEMPERATURE, MEASUREMENT OF.

256. Temperature Scale for the Domain of Liquid Helium. W. H. Keesom. *K. Onnes Lab. Leiden, Comm. Nos.* 217–228. *Suppt. No.* 71*d. pp.* 42–46, 1933. *In French.*—Since 1932 the equation relating the saturation vapour pressure of liquid helium to the temperature has been modified [see Abstract 3337 (1932)], thus producing a new scale of temperature below 2·19° K. The scales published in 1924, 1929, and 1932 are compared. J. P. A.

257. Low-Temperature Thermometry. J. C. Southard and R. T. Milner. *Am. Chem. Soc., J.* 55. *pp.* 4384–4391, *Nov.*, 1933.—A constant volume gas thermometer for use in the calibration of resistance thermometers between 14 and 90° K. has been constructed. The resistance of specimens of platinum, platinum–10 % rhodium and constantan has been determined in this range with an estimated error of about ±0·02°. A reference table of R/R_0 for platinum between 14 and 109° K. and for constantan between 14 and 26° K. has been constructed giving values for every degree in this interval. The usefulness of Henning's two constant deviation formulæ in conjunction with this reference table has been demonstrated. AUTHORS.

258. Measurement of Tube Wall Temperatures in Heat Transfer Experiments. G. M. Hebbard and W. L. Badger. *Indust. & Engin. Chem.* (*Analytical Edition*) 5. *pp.* 359–362, *Nov.* 15, 1933.—In many experimental heat transfer investigations the accuracy obtainable is usually limited by the accuracy of determination of the surface temperatures. The authors describe in detail a method in which one or more thermocouples are inserted in a hole drilled through a chord in the tube wall, the leads being carried round the tube in an annular groove, and in which special attention is paid to electrical insulation. The behaviour of the apparatus under prolonged test is discussed. H. J. H. S.

259. Vacuum Annealing Furnace. E. F. Lowry. *Rev. Sci. Instruments*, 4. *pp.* 606–609, Nov., 1933.—Metal parts to be used in the construction of vacuum devices have to be so treated that all surface and occluded gases are eliminated, and all decomposable oxides broken down and removed. Hydrogen has usually been used for this purpose, but this method is not entirely satisfactory for all metals. The author has designed and built a vacuum furnace, which can maintain a vacuum of the order of 1 micron from 0 to 1000° C. Nickel-chromium is used for the furnace tube, 1/4 in. thick and with a bore of 6 in. No rubber gaskets are used for the joints, as a new method consisting of metal surfaces coated with picein wax was developed. No leaks could be detected after several months' use. 950° C. has been found to be the most satisfactory temperature for most classes of work. L. B. F.

260. Automatic Cryostat. A. E. Cameron. *Rev. Sci. Instruments*, 4. *pp.* 610–611, *Nov.*, 1933.—A thermostat is described for use over the range 0–70° C. and in which the maximum variation is ± 1° C. An automatic relay, actuated by the usual type of toluene regulator with a mercury contact, is arranged to force colder liquid (acetone cooled by solid CO_2) from a reservoir into the thermostat and then siphon back an equal volume of liquid into the reservoir. The precautions to be observed in practice and possible improvements in design were mentioned. H. J. H. S.

261. Thermo-Molecular Pressure Differences at Low Temperatures. S. Weber and W. H. Keesom. *K. Onnes Lab., Leiden, Comm. No.* 223*b*. *pp.* 9–31, 1933. *In German.*—The great importance of thermomolecular pressure differences in the measurement of very low temperatures is stressed. The magnitude of the effect is investigated over considerable ranges of pressure and temperature for the gases Ne, A, H_2, O_2, and N_2, and the results are shown to confirm the theory of S. Weber [see following Abstract]. J. P. A.

262. Theory of Thermo-Molecular Pressure Difference. S. Weber. *K. Onnes Lab. Leiden, Comm. Nos.* 217–228. *Suppt. No.* 71*b*. *pp.* 11–33, 1933. *In German.*—The theory of the pressure difference due to thermal transpiration through a porous partition gives satisfactory formulæ for the limiting cases, when $2R/\lambda$, ratio of diameter of pore to mean free path, is either very large or very small. Previous attempts to bridge the intervening range are reviewed, and by a semi-empirical method a new formula is developed, suitable for all gases, and over the whole range. Adjusting constants introduced must be found experimentally. A thermodynamical investigation follows, in which it is shown that if the transpiration process is reversible, a cycle may be devised whose efficiency is half that of the Carnot cycle. A further investigation proves, however, that conduction through the partition cannot always be neglected, and that the process is not strictly reversible. [See preceding Abstract.]

J. P. A.

See also Abstract 165.

THERMOCHEMISTRY.

263. Partial and Integral Heats of Dilution of Cadmium Sulphate Solutions from E.M.F. Measurements. V. K. La Mer and W. G. Parks. *Am. Chem. Soc., J.* 55. *pp.* 4343–4355, *Nov.*, 1933.—The e.m.f. of the cell Cd (saturated amalgam, 11%), $CdSO_4$ (*m*), $PbSO_4$ (*s*), Pb (saturated amalgam, 6%) has been measured at 0°, 10°, 20°, and 30° C. for $CdSO_4$ concentrations of 0·0005, 0·001, 0·002, 0·005, 0·01 and 0·02-mol. By means of Wyman's value for the dielectric constant of water and the Gronwall, La Mer and Sandved extension of the Debye-Hückel theory, the previous conclusion that *a* is 3·60 Å for the concentrations 0·0005–0·01 mol. and independent of temperature from 0° to 30° is definitely confirmed. The activity coefficients of $CdSO_4$ are given for these concentrations and temperatures, and the various thermodynamic magnitudes are calculated. The relative partial molal and integral heat contents of the sulphate are also calculated, their dependence on the concentration being of the form demanded by the Gronwall, La Mer and Sandved theory. The partial molal heat capacity of $CdSO_4$ is estimated at approximately 200 cal. per °C. per mol. at 15° C. In the extended theory the equation for the activity coefficient converges more rapidly than the corresponding equation for the integral heat of dilution. Calculations of *a* based on activity coefficients are consequently more reliable than those based on equally accurate data for the heat of dilution. [See Abstract 3668 (1931).] T. H. P.

264. Heat of Formation of Binary Liquid Solutions from Their Liquid Components. J. J. Coleman and F. E. E. Germann. *J. Chem. Phys.* 1. *pp.* 847–851, *Dec.*, 1933.—It is pointed out that an equation giving the relation of the heat of formation per mol. of liquid solutions from their liquid components, to temperature and composition can be used as the foundation equation for their thermodynamical theory. The empirical equation $\Delta H = N_1 (1 - N_1) (a + \beta e^{\gamma N_1})$, in which ΔH is the heat of formation per mol of the solution, N_1 is the mol fraction of one of the components of the binary solution, and a, β and γ are constants or functions of temperature, is presented. There are two degenerate forms of this equation. There are listed values of a, β and γ (or the values of the corresponding quantities in the degenerate forms of the equation) for 59 solutions for one temperature and sometimes for several temperatures. It is noted that according to the data assembled in the *International Critical Tables*, some solutions composed of "unassociated" liquids present a behaviour more irregular than those composed of "associated" liquids. It is suggested that this unexpected behaviour may mean that some of these data are not strictly accurate. AUTHORS.

265. Ionisation Potentials and Energies of Formation of Non-Polar Molecules. J. Savard. *Comptes Rendus*, 197. *pp.* 1122–1124, *Nov.* 13, 1933. *J. de Physique et le Radium*, 4. *pp.* 650–664, *Nov.*, 1933.—Equations have been derived for the relationship between the ionisation potentials and energies of formation, and verified for the following molecules, H_2, N_2, O_2, C_2, Cl_2, Br_2, HCl, HBr, CO, CO_2, SO_2, H_2O, CH_4, $CH_3 - CH_3$, $CH_2 = CH_2$, $CH = CH$, and $CN - CN$, *viz.* $- D = 2n\,[I_m - I_a]$ for the molecule A_2, and $- D = 2n\,I_m - \Sigma n_a I_a$ for the molecule A B, where D is the energy of dissociation and I_m, etc., the ionisation potentials of the $2n$ bonding electrons in the molecule. The bonding energies of carbon atoms are found to be $2\,[I_m - 11{\cdot}26]$, $2\,[I_m - 11{\cdot}26] + 2\,[I^1{}_m - 11{\cdot}26]$, and $2\,[I_m - 11{\cdot}26] + 2\,[I^1{}_m - 11{\cdot}26] + 2\,[I^{11}{}_m - 11{\cdot}26]$ for the single, double and triple bonds respectively. H. H. Ho.

266. Temperature Coefficient of the Decomposition of Hydrogen Peroxide in the Presence of Potassium Iodide. W. C. K. Hender and R. A. Robinson. *Faraday Soc., Trans.* **29.** *pp.* 1300–1302 ; *Disc.,* 1302–1305, *Dec.,* 1933.—Data for the temperature coefficient of the reaction are given, showing the effect of concentration of catalyst, the presence of neutral salts, and the nature of the solvent. The reaction in aqueous solution agrees with the rate calculated on the assumption of collisions between peroxide, iodide, and water particles ; the effective collisions being calculated from the temperature coefficient, corrected for viscosity. A similar assumption is successful for methyl alcohol and ethylene glycol as solvents, but fails in the case of ethyl alcohol solutions, where apparently, reaction occurs between peroxide and iodide directly. The addition of neutral salts to the aqueous solutions causes only very small variations in the temperature coefficient. The reaction in methyl alcohol-water mixtures can be explained satisfactorily on the hypothesis of three-body collisions. N. M. B.

267. Limits of Inflammation of the Mixture $2H_2 + O_2$. P. Tauzin. *Comptes Rendus,* **197.** *pp.* 1046–1049, *Nov.* 6, 1933.—The lower (*a*) and upper (*b*) limiting temperatures of inflammation at various pressures (0 — 120 mm. Hg) have been plotted as pressure temperature curves, (*a*) by allowing the mixture contained in a vessel outside the furnace to expand into one inside it previously heated to the desired temperature ; (*b*) by passing into this second vessel the desired amount of the mixture at a low temperature, and then heating rapidly. For (*a*) pressure is almost constant from 420° to 520° ; for (*b*) the curve rises with increasing rapidity until it is asymptotic to the ordinate for 560° (approximately). The minimum temperature of inflammation in a heating tube $2{\cdot}5 \times 10$ cm. (424° and 0·5 mm.) was much lower than that in one 5×20 cm. (450°), but the curves cross at about 520° and 80 mm. pressure. In the smaller tube temperature of inflammation is lowered, in the larger raised a few degrees, by heating the mixture for some time at a temperature 15–35° below that of inflammation when directly heated thereto. C. A. S.

268. Flame-Speeds During the "Inflammation" of Moist Carbonic Oxide-Oxygen Mixtures. W. A. Bone and J. Bell. *Roy. Soc., Proc.* **143.** *pp.* 1–15, *Dec.* 4, 1933.—When successive $CO–O_2$ media within the range 55–80% CO were gently ignited at atmospheric pressure at the open end of a horizontal glass tube, closed at the other end, the following results were obtained : with moist media, saturated at 15° C., the maximum initial uniform flame-speed is attained at the $3\,CO + O_2$ composition ; partial drying of such media tends to move the maximum flame speed towards the $2\,CO + O_2$ composition, until with media containing 4·8 mm. moisture (corresponding to saturation at 0·8° C.)

it is at the approximate composition 70% CO. In no experiment, within the degree of drying referred to, is there any sign of a maximum flame-speed at the 2 CO + O_2 point; on the contrary, there is always a tendency for a hollow in the speed-composition curve in that region, indicating that the suppression of CO_2 dissociation by excess of either CO or O_2 is an important factor in regard to relative flame-speed. A nearly complete drying of such media by calcium chloride produces an almost constant initial uniform flame-speed of approximately 35 cm. per sec. throughout the whole composition range. The speed of the initial uniform movement set up when a moist 2 CO + O_2 medium is ignited by a heavy condenser discharge near the closed end of the tube may be 15 to 30 times greater than when the same mixture is ignited by a small flame at the open end of the tube, thus permitting escape of combustion products. The flame-speeds under the latter condition are devoid of any fundamental significance. [See Abstract **2492** (1931).] N. M. B.

269. Slow Combustion of Ethylene. W. A. Bone, A. E. Haffner, and H. F. Rance. *Roy. Soc., Proc.* 143. *pp.* 16–37, *Dec.* 4, 1933.—Investigation of the reaction of 300° C. and atmospheric pressure of various ethylene-oxygen mixtures ranging between 5 $C_2H_4 + O_2$ and $C_2H_4 + 2\ O_2$ gave the following results: Under such conditions the reaction is substantially homogeneous and is preceded by a well-marked induction period, during which a small amount of aldehyde, but no peroxide, appears. This period is practically eliminated by a previous addition of 1% of nitric oxide or acetaldehyde, and is shortened by a similar addition of formaldehyde vapour. The two first-named accelerate the subsequent reaction, but ethylene oxide retards it. Neither the induction nor the reaction periods are appreciably affected by the presence of water vapour. The most reactive mixture is 2 $C_2H_4 + O_2$, the initial oxidation product being C_2H_4O. The initial stage of oxidation does not involve any per-oxidation, but an hydroxylation of the ethylene to vinyl alcohol, which is rapidly transformed into an equilibrium mixture of the three C_2H_4O-isomers in proportions depending on temperature and pressure; at 300° C. and atmospheric pressure this ratio was approximately 4 vinyl alcohol : 10 ethylene oxide : 1 acetaldehyde; but increasing pressure shifts the equilibrium so rapidly over to acetaldehyde as almost to obliterate the ethylene oxide. The normal course of oxidation is throughout essentially a series of successive hydroxylations. N. M. B.

270. Influence of Pressure on the Spontaneous Ignition of Inflammable Gas-Air Mixtures. Part II. Pentane-Air Mixtures. D. T. A. Townend and M. R. Mandlekar. *Roy. Soc., Proc.* 143. *pp.* 168–176, *Dec.* 4, 1933.—An investigation has been made of the influence of pressure on the spontaneous ignition of pentane-air mixtures. As with butane-air mixtures, previously reported, the ignition points were found to lie in two well-defined groups, one being now above 490° C. for pressures not exceeding 3 atmospheres and the other below 350° C. for higher pressures. Transference of the ignition points from the higher to the lower group occurred at a critical pressure; for rich mixtures this was located at 1¼ atmospheres. The presence of lead tetraethyl was again found to raise the ignition points from the lower to the higher group at pressures near the critical transition pressure; on the other hand, small amounts of acetaldehyde at all pressures above atmospheric lowered the

ignition points to the lower group. The bearing of these observations on the problem of knock is discussed. [For Part I see Abstract 4165 (1933).]
AUTHORS.

271. Mechanism of Chemical Reactions. C. N. Hinshelwood. *Chem. Soc., J. pp.* 1357–1360, *Oct.*, 1933.—The possibility is considered of classifying thermal reactions into those where activation is of primary importance and those where the action of perturbing fields is of great influence in affecting the probability of transitions. In many chemical changes the rate of reaction may be shown to be equal to the rate of activation of the molecules, and in others the energy of activation is clearly the most important factor controlling the rate, even if there is no exact quantitative relationship. Such reactions are placed in the first group. Other reactions, of the second group, appear to proceed at a rate only a small fraction of that at which the necessary energy can be communicated to the molecules; in these cases the rate seems to be determined largely by a probability factor independent of temperature, as well as by activation. Various extreme examples of the two classes of reaction are considered, but it is realised that there may be a continuous transition between the two types. T. H. P.

See also Abstracts 204, 222, 328.

THERMODYNAMICS.

272. Joule-Thomson Effect in N_2O_4. K. Bennewitz and J. J. Windisch. *Zeits. f. phys. Chem.* 166. *Abt.A.* 5–6. *pp.* 416–427, *Oct.*, 1933.—A special apparatus is devised for the study of the Joule-Thomson effect in N_2O_4, particularly in the neighbourhood of the critical point. The dependence of the effect upon the density of the gas, for the critical temperature, is found, and the bearing of the results on the problem of dissociation of N_2O_4 at the critical point discussed. J. P. A.

273. Variation with Pressure of the Ratio of the Specific Heats of Hydrogen. A. van Itterbeek. *K. Onnes Lab., Leiden, Comm. Nos.* 217–228. *Suppl. No.* 70*b. pp.* 7–12, 1933. *In English.*—From previous measurements on the velocity of sound in hydrogen gas at liquid hydrogen temperatures, the variations of $C_p/C_v = \gamma$ and of C_v, with pressure up to 0·6 atmosphere are obtained. For this purpose the third virial coefficient is first calculated over the range of pressure and temperature required. γ always exceeds 1·667, and is almost a linear function of pressure. In the temperature range 17·5° to 20·50° K. the value of γ at constant pressure passes through a minimum; C_v varies comparatively little. J. P. A.

274. Second Virial Coefficient, and the Specific Heats of Helium at Liquid Helium Temperatures. A. van Itterbeek. *K. Onnes Lab., Leiden, Comm. Nos.* 217–228. *Suppl. Nos.* 70*c. pp.* 13–18, 1933. *In French.*—From measurements previously made, the ratio of the specific heats $C_p/C_v = \gamma$, and of C_v, are calculated for helium at low temperature. The second virial coefficient, which is required for the calculation, is investigated, and a formula found for its variation with temperature between 3·70° and 14·50° K. γ always exceeds 1·667, and increases with increasing pressure [see preceding Abstract]. C_v lies a little below 2·979, and varies very little with temperature. J. P. A.

275. Specific Heat of Liquid Helium. W. H. Keesom. *K. Onnes Lab., Leiden, Comm. Nos.* 217–228. *Suppt. No.* 71*e. pp.* 47–52, 1933. *In French.*—The paper consists of two parts. In the first the difference between the specific heats of liquid helium I and liquid helium II is shown thermodynamically to involve an anomaly in the latent heat of vaporisation. The experimental results of Dana and K. Onnes are shown to be in accord with this. In the second part various suggestions as to the nature of helium I and helium II are put forward, but no definite conclusions are reached. The author mentions that work designed to overcome the technical difficulties of an X-ray analysis to determine this matter is in progress. L. G. C.

276. Thermodynamic Considerations on a New Kind of Transition Point. O. Halpern. *J. Chem. Phys.* 1. *pp.* 880–881, *Dec.*, 1933.—According to previous experiments [see Abstract 5377 (1933)], liquid helium shows a " transition point " with discontinuity in the values of its specific heat and expansion coefficient. It has not been possible, however, to observe the coexistence of the two " phases." This fact is here explained on a thermodynamic basis. Coexistence of two phases at a transition point can only be anticipated if the two phases exhibit a discontinuity in energy. An analogy is made with similar cases like that of the " transition point of supraconductivity." AUTHOR.

277. Thermodynamical Proof of the Boltzmann Formula. N. Barbulescu. *Soc. Române Fiz., Bul.* 35. *pp.* 69–73, *June–July,* 1933. *In French.*—An expression is deduced for the entropy of a gaseous mass, composed of molecules possessing different energies, which leads directly to the Boltzmann-Planck formula. R. W. P.

278. Thermodynamic Constants of Iodine Monochloride, Iodine Monobromide and Bromine Monochloride in Carbon Tetrachloride Solutions. C. M. Blair, Jr., and D. M. Yost. *Am. Chem. Soc., J.* 55. *pp.* 4489–4496, *Nov.*, 1933.—The partial vapour pressures of ICl and Cl_2 above their solutions in CCl_4 have been measured and the free energy of formation of the monochloride deduced. The heats of solution of I_2 and Br_2 in CCl_4 and the heats of formation of ICl, IBr and BrCl in the same solvent have been determined. These data, combined with known free energy values, have been used to deduce values of the thermodynamic constants of the halogens and inter-halogen compounds dissolved in CCl_4, as follows :—

Substance	I_2 in CCl_4	Br_2 in CCl_4	Cl_2 in CCl_4	ICl in CCl_4	IBr in CCl_4	BrCl in CCl_4
Free Energy (cal/mole)	2660	389	1110	−2133	−153	393
Heat Content (cal/mole)	5990	712	−3720	−2835	1721	−1882
Entropy (cal/deg.)	39·1	36·8	37·1	38·3	38·5	36·9

J. S. G. T.

279. Thermodynamics of Ionised Water in Potassium and Sodium Bromide Solutions. H. S. Harned and W. J. Hamer. *Am. Chem. Soc., J.* 55. *pp.* 4496–4507, *Nov.*, 1933.—Measurements of the e.m.f. of the cells H_2/MOH (0·01), MBr(m)/AgBr/Ag and H_2/HBr(0·01), MBr(m)/AgBr/Ag have been made with aqueous solutions from 0° to 60° C. M denotes potassium or sodium. From the results the dissociation constant of water has been computed and the values are found to agree with those previously deduced from cells containing HCl and KCl. The values of the normal potential of the Ag-AgBr electrode, E_0 volts, at t° C. is given by $E_0 = 0 \cdot 07169 - 5 \cdot 259 \times 10^{-4}(t - 25) - 3 \cdot 022 \times 10^{-6}(t-25)^2$ with an accuracy of $\pm 0 \cdot 1$ mV. Methods are indicated for computing the activity coefficient of HBr and the ionic activity coefficient product of water in KBr and NaBr solutions. The partial molal heat contents of HBr in KBr and NaBr solutions at 0°–60° have been calculated and the values compared with those of HCl in chloride solutions. Values of the total heat content of the dissociation of water, the relative partial molal heat content of the H^1 and OH^1 ions in KCl, KBr and NaBr solutions at 0°–60° are calculated. Good agreement is found with calorimetric data from heats of neutralisation at 20° C. J. S. G. T.

280. Thermodynamic Constants of Lithium Sulphate. Y. Ueda. *Tohoku Univ., Sci. Reports,* 22. *pp.* 879–891, *Oct.,* 1933.—The thermodynamic constants for lithium sulphate have been accurately determined, the values being the experimental results obtained with galvanic cells, tensimeters, and an adiabatic calorimeter. [See also Abstract 4981 (1933).] AUTHOR.

See also Abstracts 44, 222, 243, 247, 248, 249, 250, 261, 262, 271, 334.

VAPOUR PRESSURE.

281. Relations Between the Maximum Vapour Pressures of Organic Series. E. Lucatu. *Soc. Române Fiz., Bul.* 35. *pp.* 127–128, *Aug.–Oct.,* 1933. *In French.*—The maximum vapour pressures of a number of organic substances, grouped according to the series to which they belong, are tabulated so as to show that as the number of carbon atoms in the series increases in an arithmetical progression so the vapour pressure decreases in a geometrical progression, having a ratio which increases linearly with temperature and at any one temperature is approximately the same for each series. R. W. P.

282. Partial Vapour Pressures and Refractivities of Mixtures of Benzene with Nitrobenzene, Phenol, Benzyl Alcohol, or *p*-Dichlorobenzene. A. R. Martin and C. M. George. *Chem. Soc., J. pp.* 1413–1416, *Oct.,* 1933.—Partial vapour pressures (at 70°) and refractivities (at 25°) of mixtures of benzene with nitrobenzene, phenol, benzyl alcohol, or *p*- dichlorobenzene have been measured. The hydroxylic compounds are much more associated than the others, and *p*-dichlorobenzene is slightly associated. The results are discussed from the point of view of dipolar and van der Waals forces. AUTHORS.

283. Vapour Pressures of Propane and Propylene. A. W. Francis and G. W. Robbins. *Am. Chem. Soc., J.* 55. *pp.* 4339–4342, *Nov.,* 1933.—An all-glass apparatus has been devised for determining vapour pressures above atmospheric. The vapour pressures of propane and propylene have been determined in the same apparatus for the first time above 0°. The determinations cover a temperature range of 27 to 64° for propane and 29 to 46° for propylene. AUTHORS.

ACOUSTICS.

284. Acoustical Behaviour of a Gas with Several Independent Internal Energy States. W. T. Richards. *J. Chem. Phys.* 1. *pp.* 863–879, *Dec.*, 1933.—The method founded by Einstein for the description of the acoustical behaviour of a dissociating gas has been extended to cover a non-dissociating gas in which five groups of internal energy states have different relaxation times. Since the resulting expressions are unwieldy, approximations based on them, which permit the rough description of experiment, have been given. The study of the variation of the velocity of sound with frequency demonstrates differences in the relaxation times of the various states. The variation of the velocity of sound with pressure shows in addition effects due to three-body collisions or to radiation from optically active states. It has been suggested to treat the temperature coefficient of the kinetic relaxation time by the introduction of an empirical quantity which may be called " the activation energy of collision." By this means a rough kinetic analysis of the transition probability is possible. In gaseous mixtures, the relative spatial and energetic effectiveness of various types of collisions in exciting internal energy may be compared. [See also Abstract 4992 (1933).] AUTHOR.

285. Intensity Measurements of Ultrasonic Vibrations in a Restricted Field. E. and H. Biancani and A. Dognon. *Comptes Rendus*, 197. *pp.* 1070–1071, *Nov.* 6, 1933.—In the investigation of the effects of ultrasonic waves on small living objects, difficulties have been encountered in the measurement of the energy distribution in the vibrating medium, due chiefly to the small dimensions of the container. A small tubular calorimeter is described, in which part of the ultrasonic energy is absorbed, and temperature rises in several liquids observed. It is shown that the chief factor in the absorption and hence transmission is the viscosity of the liquid. The practical application to observations on small objects is described. J. E. R.

286. Propagation of Ultra-Short Sound Waves through Electrolytes. S. Oka. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 413–419, *Nov.*, 1933. *In German.*—The theory of propagation of ultra-short sound waves through an electrolyte, developed by Debye, is here extended by consideration of the relaxation force and the force of electrophoresis. An expression is derived for the potential of waves of this type. A. W.

287. Progress in Noise Measurements. P. L. Alger. *Elect. Engineering*, 52. *pp.* 741–744, *Nov.*, 1933.—The initial standards of acoustic measurements presented by H. Fletcher [see Abstract 5387 (1933)] are of extreme importance and form a new basis for noise measurements. In the present paper the salient features of these standards are outlined, the development of total noise meters discussed, and methods of making noise measurements indicated. The new reference level of a pure note at 1000 ~ is on the threshold of hearing so that negative levels will be avoided. G. A. V. S.

See also Abstracts 29, 52, 273.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

288. Classification of Bridge Methods of Measuring Impedances. J. G. Ferguson. *Elect. Engineering,* 52. *p.* 414, *June,* 1933. *Abstract. Bell System Techn. J.* 12. *pp.* 452–468, *Oct.,* 1933.—An analysis is made of the requirements for satisfactory operation of the simple four-arm bridge when used for impedance measurements. The various forms of bridge are classified into two major types called the ratio-arm type and the product-arm type, based on the location of the fixed impedance arms in the bridge. These two types are subdivided further, based on the phase relation which exists between the fixed arm impedances. Eight practical forms of bridges are given, three of them being duplicate forms from the standpoint of the method of measuring impedance. These bridges together allow the measurement of any type of impedance in terms of practically any type of adjustable standard. The use of partial substitution methods and of resonance methods with these bridges is discussed, and several methods of operation are described which show their flexibility in the measurement of impedance. AUTHOR.

289. Bridge for Small Inductances. A. T. Starr. *Journ. Sci. Instruments,* 10. *pp.* 361–362, *Nov.,* 1933.—The bridge, the circuit of which is given in Fig. 2, is a modification of the series resonant bridge of Fig. 1. C′ is a fixed condenser and C is variable. When the bridge is balanced, L is given (approx.) by $\delta C/(wC')^2$. C′ may conveniently be an air dielectric condenser. The arrangement shown in Fig. 3 offers practical conveniences. The modified bridge is less sensitive than the ordinary series bridge. G. E. B.

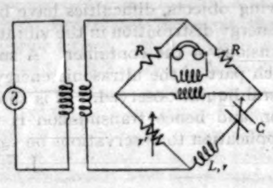

Fig. 1. Series-resonant bridge

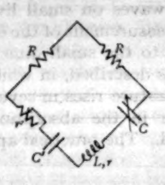

Fig. 2. Modified bridge

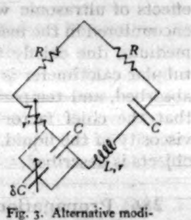

Fig. 3. Alternative modification of bridge

CONDUCTION AND DISCHARGE IN GASES.

290. Energy Ratios at Glowing Kathodes in Discharge Tubes with Vapour or Gas Filling. E. Kleiner. *Ann. d. Physik,* 18. 5. *pp.* 529–556, *Nov.,* 1933.—Consideration of the energy conditions at the kathode of a mercury vapour discharge tube showed that the expression for the energy consumption consists of two terms, one depending on the mean value and the other on the effective value of the current. The term depending on the effective value of the current corresponds to the power consumption in the cross sectional resistance; the mean value term is concerned with the processes at the surface of the kathode, such as the work of driving out electrons, kinetic energy of impinging ions and heat of recombination. The introduction of a form factor makes it possible to refer practically all cases to the effective value of the load current. The energy balance is discussed by means of heating characteristics, which give the relation between kathode temperature and current. The dependence of the temperature rise on the form factor is obtained from theoretical considerations. Two kinds of characteristics are distinguished, according to whether the characteristics for different form factors intersect or not. The latter is normally the case, the former being caused by increased work of driving out electrons. Accurate quantitative measurements gave results in good agreement with theory. Research on tubes filled with the rare gases also gave results in confirmation of the theory. With these it was found that the part contributed by the term depending on the effective current to the energy balance was in general preponderant, but that the part due to the mean value term increased with increasing ionisation. A. W.

291. Electron Density and Electron Temperature in Electric Arcs. R. Mannkopff. *Zeits. f. Physik*, 86. 3–4. *pp.* 161–184, *Oct.* 31, 1933.—From observations of ionic migration in electric arcs and also from measurements of the degree of ionisation of additions to the arc gas, values may be found for the electron density and the degree of ionisation. Both methods give a degree of ionisation of 10^{-2} to 10^{-3}, which exceed the expected value by 10 to 100 times. Line spectra free from self-reversals, which are necessary for intensity measurements, may be obtained by observation in the direction of the axis of the arc. The observed degree of ionisation shows that in arcs between carbon or metal electrodes in air at atmospheric pressure, excitation and ionisation due to electron impact is much greater than that due to atom impact. A temperature estimation based on the degree of ionisation of auxiliary gases thus gives the electron temperature and not the gas temperature. For the carbon arc the value obtained is 6000° to 8000°, which is in agreement, within the limits of error, with the value of 6700° obtained by Ornstein for the gas temperature from observations of the CN bands. Under certain assumptions it is found that the difference between the electron temperature and the gas temperature should be less than 20° for arcs at atmospheric pressure. The temperature equilibrium is almost complete and the application of Saha's equation appears to be perfectly legitimate. A. W.

292. Effect of Ultra-Violet Illumination on the Electric Spark. J. Claussnitzer. *Phys. Zeits.* 34. *pp.* 791–807, *Nov.* 1, 1933.—The results of many workers are reviewed, with the object of explaining the apparent discrepancies and separating the various effects from one another. A detailed summary of the principal experimental results is given (*a*) for sphere spark-gaps and (*b*) for sphere and plane spark-gaps. It is shown that the kink in Toepler's curve showing the behaviour of the initial potential, effects a clear division between the observed phenomena when ultra-violet light is used to illuminate the spark-gap. The width of the gap has also an appreciable effect. A. W.

293. Spark Retardation. F. Bath. *Zeits. f. Physik*, 86. 5–6. *pp.* 275–296, *Nov.* 10, 1933.—Apparatus is described for the automatic measurement of spark retardation times. Measurements were made of spark retardations under various ionisation conditions in CO_2, N_2 and H_2 at atmospheric pressure. The precautions which must be observed while carrying out the observations are discussed in detail. When these precautions are taken it was found that Zuber's law of proportionality between the spark number and the ionisation may be extended to the case of extremely weak radiation. There is, however, a residual effect which in the case of N_2 and H_2 varies considerably with the time and is noticeable even in the case of CO_2. In consequence v. Laue's relation was, for extremely weak radiation, only found to hold for CO_2 and not for N_2 and H_2. The contribution of the volume ionisation to the spark formation compared with that of the surface ionisation is least for H_2 and greatest for CO_2. Behind 7 cm. of lead the mean retardation time in CO_2, for an excess voltage of 1000 volts above the sparking potential of 3100 volts, was found to be 20 minutes, the maximum for the apparatus employed. A. W.

294. Ionisation of Rare Gases by Slow Alkali Ions. O. Beeck. *Ann. d. Physik,* 18. 4. *pp.* 414–415, *Oct.,* 1933.—A correction is applied to some previous work on Ne, A, Kr, and Xe [see Abstracts **952** (1931) and **5214** (1932)]. The results of the author are in agreement with those of Mouzon, except in the case of K ions in A. An explanation of this discrepancy is suggested. H. J. H. S.

295. Polarisation of Light Emitted by Canal Rays. W. Romberg. *Ann. d. Physik,* 18. 5. *pp.* 515–528, *Nov.,* 1933.—A brief summary is given of recent knowledge. Using matrix elements and with the aid of a formula derived by Gordon, the intensity formula is calculated, with and without the assumption of electron spin. The polarisation of the first lines of the Lyman and Balmer series is then calculated as a function of the energy of the protons and the results are shown in a series of curves. It was shown that the amount of polarisation decreased fairly rapidly as the energy increased and that at about 75,000 e.V. the light was practically unpolarised. The polarisation-energy curve was almost identical for the first lines of the Lyman and Balmer series and also for the lines $H\alpha$, $H\beta$ and $H\gamma$ on the assumption of electron spin. The agreement between theory and experiment, which is not exact but of the same order of magnitude, is discussed. H. J. H. S.

296. Electron Microscope. G. Valle. *Elettrotecnica,* 20. *pp.* 697–705, *Oct.* 25, 1933.—An historical account of the theory and of the experimental developments which have resulted in the electron microscope. The latter is analogous to the optical microscope, beams of electrons playing the part of light beams and focussing being provided by electric and magnetic fields. Theoretically the resolving power of the electron microscope is vastly superior to that of the optical microscope. F. C. C.

297. Electron Optical Immersion Objective. H. Johannson. *Ann. d. Physik,* 18. 4. *pp.* 385–413, *Oct.,* 1933.—An arrangement which acts as a short focus "electrostatic lens" is described. It consists of two concentric cylinders, fitted with diaphragms at one end and separated by 1 mm. A positive potential of 750 volts is applied to the outer cylinder (anode) and a variable potential of either sign to the inner ("grating"). The "lens" is placed close to an oxide kathode and the grating potential necessary to form images of the kathode on a fluorescent screen for various kathode-grating distances is determined; further electron optical properties of the system are fully investigated and a series of typical curves is given. Distortion of the image due to curvature, astigmatism, and spherical and chromatic aberration is discussed and methods of correction are suggested. H. J. H. S.

298. Combined Electric and Magnetic Electron Lens. H. Johannson and W. Knecht. *Zeits. f. Physik*, 86. 5–6. *pp.* 367–372, *Nov.* 10, 1933.—A system composed of an electrostatic lens of focal length f_e, placed within the field of a magnetic lens of focal length f_m, is described. The validity of the optical law $1/f = 1/f_e + 1/f_m$ for the evaluation of the power of the combination is verified theoretically and experimentally for various values of lens potential and current. H. J. H. S.

299. Electron-Optical Images Obtained with Photoelectrons. E. Brüche. *Zeits. f. Physik*, 86. 7–8. *pp.* 448–450, *Nov.* 15, 1933.—A freshly polished zinc plate, used as a kathode, was irradiated by an intense ultra-violet source. The photoelectrons emitted, after acceleration by 30 kV, were focussed by means of a magnetic " lens " on a fluorescent screen, yielding a slightly magnified image of the kathode. H. J. H. S.

300. Splitting a Kathode Stream by a Cylindrical Probe. W. Rollwagen. *Zeits. f. Physik*, 86. 3–4. *pp.* 157–160, *Oct.* 31, 1933.—In connection with certain potential measurements in a stream of kathode rays the author used a silver wire probe 0·05 mm. diameter. It was noticed on bringing the wire into the stream with its axis perpendicular to the direction of the rays, that the single primary stream was divided into two divergent streams behind the probe. The splitting occurred whether the wire was charged to a positive or a negative potential with respect to the accelerating plates of the kathode stream. A simple explanation is given relative to certain differences observed with the probe " positive " or " negative " When the probe is not accurately centred in the primary stream the two divergent streams are of unequal intensity. It is shown also that a somewhat diffuse primary stream is divided into two relatively sharp divergent pencils. A. B. W.

301. Chemical Action in the Glow Discharge. Part XI. A. Brewer and P. D. Kueck. *J. Phys. Chem.* 37. *pp.* 889–896, *Oct.*, 1933.—The decomposition of NO_2 in the glow discharge was observed at 170°. At this temperature the gas is in the form of NO_2 molecules entirely. The decomposition has a negative temperature coefficient. It is concluded that the mechanism of the reaction does not involve the intermediate formation of NO and that decomposition is from ion clusters directly to N_2 and O_2. The bearing of these results upon the fixation of N_2 is discussed. [For Part X, see Abstract 5338 (1932).] A. S. C. L.

302. Chemical Action in the Glow Discharge. Part XII. J. W. Westhaver. *J. Phys. Chem.* 37. *pp.* 897–906, *Oct.*, 1933.—NH_3 decomposes into its elements in the glow discharge at a rate proportionate to the current and independent of the pressure. Below 250° the temperature coefficient is slightly less than unity and slightly above it, for higher pressures, above this temperature. The presence of inert gases up to 80 % does not retard the decomposition ; but H_2 does in proportion to the number of H ions present. A. S. C. L.

303. Heterogeneous Chemical Reactions in the Silent Electric Discharge. Part VI. S. Miyamoto. *Hiroshima Journ. Sci.* 3. *pp.* 347–366, *Oct.*, 1933. *In English.*—The action of hydrogen on various metallic nitrates and nitrites under the influence of the silent discharge is described. Nitrite, ammonia, metal and/or oxide are formed in most cases from the nitrates, whilst the nitrites yield ammonia, nitrogen peroxide, and oxide, hydroxide, or metal. In no case has oxide, hyponitrite, or hydroxylamine been detected among the reaction products. [For Part V, see Abstract 3743 (1933).] H. F. G.

304. Formation of Ozone Corona Discharge. H. G. Thode and A. C. Grubb. *Am. Electrochem. Soc., Trans.* 63. *pp.* 401–418, 1933. —An a.c. corona discharge is used to study the formation of ozone at velocities of oxygen from 0 to 12 litres per hour and at 38, 65 and 90 watts. Results are obtained with a dielectric surface of glass, paraffin, stearic acid and sputtered platinum. The yield of ozone from the tubes increased in the order: stearic acid, paraffin, glass, and platinum. A calculation is made of the thermal equilibrium temperature, M/C and M′/N ratios. An explanation is offered for the behaviour of the surfaces on the basis of facts found in other investigations, and on the basis of the explanations offered by Lind and by Brewer and Westhaver for the formation and decomposition of ozone. AUTHORS.

305. Electric Arc Discharge in Water. H. D. Carter and A. N. Campbell. *Am. Electrochem. Soc., Trans.* 63. *pp.* 419–423; *Disc.*, 423, 1933.—The solid, soluble and gaseous products of the l.t. arc discharge in water were investigated. Solid compounds of hydroxide nature were obtained with carbon and metal electrodes. The quantitative effect of water temperature and pressure on the rate of production of gases (reaction rate) was studied; measurements of the arc temperature, and its variations with water temperature, were carried out. AUTHORS.

306. High Pressure Ionisation Chamber for the Study of γ-Rays and Neutrons. P. Savel. *J. de Physique et le Radium*, 4. *pp.* 609–612, *Oct.*, 1933.—A high pressure ionisation chamber is connected to a sensitive Hoffmann electrometer. The gases hydrogen, nitrogen and argon were successively used and the variation in the ionisation observed over a pressure range from 1 to 30 atmospheres. In all cases the readings were irregular for 2 or 3 hours after filling the chamber. The ionisation produced by the complex radiation emitted from Be on bombardment with the α-particles from Po was compared with that produced by the γ-rays from a Ra standard. The contribution of the neutrons was clearly demonstrated. F. C. C.

307. Amplification and Recording of Rapid Geiger-Müller Counter Impulses. G. L. Locher. *Frank. Inst., J.* 216. *pp.* 553–558, *Nov.*, 1933.—A circuit is described which allows impulses to be recorded at a rate of about 1400 per sec. Apart from the effect of the time constants of the amplifying circuit, the speed of operation of Geiger-Müller counters is limited by (1) the resolving time of the counting device, (2) the time constant of the counter resistance and the coupling condenser, (3) the amplification factor of the amplifier, (4) the size and materials of the counter. The first difficulty can be fairly easily overcome; the last three are related to one another and cannot be treated separately. Photoelectric processes are important, particularly if the radiation generated by the discharge contains frequencies above the photoelectric threshold of the metal of the cylinder-electrode. F. C. C.

308. Air Ionisation Chamber for Measuring Low Voltage X-Ray Intensities in Röntgens. F. M. Uber. *Rev. Sci. Instruments*, 4. *pp.* 649–650, *Dec.*, 1933.—A detailed structural design of a parallel plate ionisation chamber for measuring low voltage X-ray intensities in röntgens is described. Intended for use in dosage-meters where stability and simplicity are important factors, it permits the entire apparatus to be housed in a single cabinet without external accessories. Air absorption corrections are made directly and conveniently. AUTHOR.

309. Sensitive Design of Geiger-Müller Counter. T. R. Cuykendall. *Rev. Sci. Instruments*, 4. *pp.* 676–678, *Dec.*, 1933.—This preliminary investigation indicates that the sensitivity of a Geiger-Müller counter for γ-rays and hard X-rays can be increased from 2 to 3 times, or perhaps more, by the introduction into the counter of suitably disposed vanes, the effect of which appears to be to increase the effective surface from which the active recoil electrons or photoelectrons come. AUTHOR.

See also Abstracts 34, 60, 172, 223, 265, 329, 353, 384.

CONDUCTION IN SOLIDS AND LIQUIDS.

310. Valve Voltmeter with Logarithmic Response. F. V. Hunt. *Rev. Sci. Instruments*, 4. *pp.* 672–675, *Dec.*, 1933.—A new valve voltmeter which has a response proportional to the logarithm of the input-voltage is described. The operation of the device is based upon the distortion of the plate-current wave form occurring in a valve of the " variable-mu " type, and upon the use of a diode rectifier to select only that portion of the wave which has been " compressed " by the curvature of the valve characteristic. The elementary circuit may be cascaded for extension of the range of input voltage over which the response is logarithmic. The speed of response of the device to changes in signal intensity is practically unlimited, and the frequency fidelity is only slightly inferior to that of a comparable impedance-coupled amplifier designed for the same frequency band. Commercially available valves are used throughout. AUTHOR

311. Rectifying Peak Voltmeter as a Standard Instrument. A. T. Starr. *Phys. Soc., Proc.* 46. *pp.* 35–46, *Jan.* 1, 1934.—The paper describes a peak voltmeter using overbiased rectifying valves. Various errors are discussed and calculated. AUTHOR.

312. Electrical Resistance and Heat in Metals. C. R. Underhill. *Frank. Inst., J.* 216. *pp.* 629–632, *Nov.*, 1933.—By making the assumption that the electrical resistance is zero at 0° K. and equating the total heat stored in a thermally insulated conductor when heated electrically from 0 to T° K. to the electrical energy dissipated therein it is found that $R_m = (m/a) C_m T$, where R_m = mean resistance from 0 to T° K.; m = mass, a = atomic weight and C_m = mean atomic heat. Graphical results are given for Cu and Fe up to a maximum temperature of 200° K. It is suggested that a refinement of the treatment outlined might lead to a general equation for temperature-coefficients of resistance at all temperatures. R. W. P.

313. Electron Conductivity of Cuprous Oxide. W. Schottky and F. Waibel. *Phys. Zeits.* 34. *pp.* 858–864, *Dec.* 1, 1933.—The general mechanism of semi-conductivity is briefly reviewed with special reference to its relation to the Hall effect. Measurements of the Hall effect in Cu_2O made at temperatures varying from − 180° C. to 850° C. lead to the conclusion that the effect changes sign at about 400° C. - 500° C. This result supports the view that the mechanism of semi-conduction changes in this temperature region and the theoretical implications of this are discussed. J. E. R. C.

314. Device for Producing Small Direct Currents of Known Magnitude. A. Wikstrom. *Rev. Sci. Instruments,* 4. *pp.* 612–614, *Nov.,* 1933.—The paper describes an apparatus devised for producing small currents of known magnitude, but primarily of the order of $10^{-12} - 10^{-17}$ ampere. The most satisfactory method was to keep the capacity constant and vary the potential ($dQ/dt = CdE/dt$ or $dQ/dt = EdC/dt$). Thus a slide wire potentiometer device of special design was constructed. It has the advantages of the vacuum tube method of producing small currents and in addition an equal range for currents of either sign, is always ready for use, and does not require calibration. Suggested applications of the device are (1) as a standard, (2) to measure high resistances of the order of $10^{10} - 10^{14}$ ohm, (3) to measure instantaneous values of currents. R. L.

315. Amplification of Small Direct Currents. K. Zuber. *Helv. Phys. Acta,* 6. 7. *pp.* 495–503, 1933. *In German.*—The conditions which limit the effective sensitivity obtainable in the valve amplification of direct photoelectric or ionisation currents are discussed, and a new amplifying circuit is described. The current from the space-charge grid of the valve is used to compensate the anode current, and by suitable choice of resistance values and potentials it is possible to reduce the effects of battery variations to about one-hundredth of those which arise from the simple circuit. A correspondingly higher sensitivity is thus obtainable.

D. H. F.

316. Balanced D.C. Amplifying Circuits. L. A. Turner. *Rev. Sci. Instruments,* 4. *pp.* 665–671, *Dec.,* 1933.—Three different circuits for use with a single valve in order to balance out effects of fluctuations of the e.m.f. of the plate battery are described. The theory of the circuits is worked out and the expressions for the galvanometer current given. The circuit in which the stability of balance depends upon the constancy of the amplification factor, μ, is found to be the most stable. A modified two-valve circuit operating on this principle is suggested. AUTHOR.

317. Suppression of Harmonics of the Einthoven String Galvanometer. A. H. Bebb. *Journ. Sci. Instruments,* 10. *pp.* 362–364, *Nov.,* 1933.—It is shown to be possible to suppress the third harmonic of the galvanometer by suitably proportioning the length of the string and magnets and adjusting the size of the gap. It appears impossible to suppress both the third and fifth harmonics by geometric means, but it is shown that the fifth harmonic may be suppressed by using a suitably tuned shunt. G. E. B.

318. Lacquer-Coated Resistors. L. F. Curtiss. *Rev. Sci. Instruments,* 4. *pp.* 679–680, *Dec.,* 1933.—A compact form of resistor of high resistance, consisting of graphite on pyrex, sealed in glyptal lacquer, which has been found very satisfactory is described. Resistors of this type with a resistance of 10^{8} to 10^{12} ohms may be made with comparative ease. They are not appreciably affected by changes of temperature or of humidity. Their small size renders them useful where economy of space is essential. AUTHOR.

319. Effect of Tension on the Resistance of Nickel Wire Maintained at Various Temperatures. S. Arzybaschew and V. Jushakow. *Zeits. f. Physik*, 86. 7–8. *pp.* 521–522, *Nov.* 15, 1933.—Experiments previously described [see Abstract 588 (1931)] have been repeated and confirmed using a sample of nickel which contained only 0·2 % impurity. The investigation is now extended to the temperatures given by solid CO_2 and by liquid air. The conclusion that at lower temperatures the effect of tension is to produce a larger diminution in resistance is confirmed at −83° C., but at −190° C. a smaller decrease in resistance is obtained. R. W. P.

320. Preparation and Properties of Thin Lead Sulphide Layers with Special Consideration of their Detector Effects. Part II. G. Brückmann. *Kolloid Zeits.* 65. *pp.* 148–161, *Nov.*, 1933.—The lead sulphide mirror, prepared from purified initial materials, possesses a stoichiometric composition and a well-developed crystal lattice. Optical measurements show a strong dependence of absorption and reflection upon the thickness of the layer. A careful investigation of the detector effect has afforded the following results: (*a*) Dependence on the layer thickness; (*b*) well crystallised (coarse) layers have a better detector effect than fine grained varieties; (*c*) the substratum material of thick layers has no apparent influence on the effect; (*d*) chemically purified lead sulphide possesses the same effect as the ordinary variety, and the facts now ascertained appear to oppose the stop-layer theory; (*e*) the existence of a solid insulating layer at the contact spot is found to be improbable; activating experiments produce no improvement of the detector effect, likewise also the installation of radioactive substances; (*f*) the electronic current, in general, flows from electrode to lead sulphide, but exceptions occur with the use of polished soft metals as substratum or with a graphite electrode. A comprehensive survey is included of the theories of the plane rectifier and crystal detector, and a suitable combination of some of these ideas is proposed. Possible layer structures are discussed. [For Part I see Abstract 5410 (1933).] H. H. Ho.

321. Supraconductivity of Alloy Systems. J. F. Allen. *Phil. Mag.* 16. *pp.* 1005–1044, *Nov.*, 1933.—The supraconductivity of the following alloy systems has been examined: Au-Sn, Au-Pb, Ag-Sn, Ag-Pb, Cu-Sn, Cu-Pb and Tl-Sn. These included three structural types. (1) Simple eutectic mixtures, having a constant supraconductivity point except in the neighbourhood of the boundaries; (2) simple mixed crystals or solubility phases having a continuously varying supraconductivity point and transition interval; (3) a double series of mixed crystals having supraconductivity characteristics similar to the second type. In all three types the supraconductivity curve was a continuous function of the concentration, indicating that the effect is a property of the complete structure of an alloy and not of any one of its components. R. W. P.

322. Supraconductivity and its Theoretical Importance. C. Benedicks. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23*A*. 20. *pp.* 1–29, 1933. *In German.*—The metals showing supraconductivity are grouped round the fourth vertical series of the periodic table. Supraconductivity appears also in binary mixed crystal series. It is a fundamental fact that it occurs in the same way both between atoms of different kinds and between similar ones. The systems In-Pb, Hg-Pb, Bi-Pb, Sn-Tl, In-Tl, Pb-Tl are described in detail and the observations show that the transition points fit the requirements of the equilibrium diagrams without the necessity for special assumptions. Certain intermetallic phases have higher transition points than their components and a compound such as for example Au_2Bi can become supraconducting although neither of its components have been observed in the supraconducting state. A survey of the gas kinetic theory is given, together with a detailed treatment from the standpoint of the phoretic electron theory with satisfactory results. In conclusion the author states that the supraconductivity of metals and alloys lends strong support to the existence of molecular currents. R. L.

323. Variation in the Electrical Conductivity of Hydrous Minerals with Temperature. S. Shimizu. *Tohoku Univ., Sci. Reports*, 22. *pp*. 633–661, *Oct*., 1933.—The electrical conductivities of some hydrous minerals such as: the hydrous-aluminium silicate minerals, the aluminium mono-hydrate minerals, and alunite have been thoroughly studied, and the results compared with the investigations of thermal analysis by others. It was found that these conductivities show discontinuous variations in various ranges of temperatures, *e.g*., 100° C. to 200° C., and 450° C. to 650° C., previously defined as the dehydration temperature regions in a thermal investigation, and that the abrupt decrease of conductivity from 900° C. to 1000° C. corresponds to a prominent heat evolution near 1000° C. in the case of thermal analysis. The decrease is nearly proportional to the ratio of SiO_2/Al_2O_3 contained in the hydrous minerals. It is concluded that the measurement of the variation of electrical conductivity with temperature is a useful method of investigating the mechanism of dehydration, as well as that of the thermo-balance. Lastly the various states of metakaolin after dehydration are considered in connection with its electrical conductivity. AUTHOR.

324. Investigation of the Au-Cu System by Means of Resistance Measurements at Low Temperatures. V. Pospíšil. *Ann. d. Physik*, 18. 5. *pp*. 497–514, *Nov*., 1933. *From the Reichsanstalt*.—Measurements are made of the ratios of the electrical resistivities at –195 and –252° C. to the resistivity at 0° C. for a series of Au-Cu alloys containing from 10 to 100 atomic per cent Au. The curves obtained when these results are plotted against the composition indicate that the alloys produced by quenching consist of mixed crystals. In the tempered state, however, the presence of the intermetallic compounds $AuCu_3$ and AuCu is indicated in alloys of the appropriate chemical compositions. R. W. P.

325. Determination of Limiting Equivalent Conductivity. K. Gostkowski. *Acta Physica Polonica*, 2. 2. *pp*. 215–218, 1933. *In German*.—By an investigation of the influence of certain electrolytes upon the electrokinetic potential, the author has derived a very simple expression for the relationship between the latter potential and the equivalent conductivity, viz., $\lambda'\infty/\lambda''\infty = \mathrm{K}\,V''/V'$. A simple experimental method based on the above relationship has been devised, which is claimed to be more simple than the usual process for determining equivalent conductivity. H. H. Ho.

326. Theory of Unstationary Processes in Electrolyte Solutions and Problems Relating to Electrolytes. H. Falkenhagen and W. Fischer. *Phys. Zeits*. 34. *pp*. 786–788, *Nov*. 1, 1933.—A continuation of previous papers [see Abstract 4239 (1933)] in which the complex phenomena of h.f. conductivity are considered in relation to the relaxation time of the ionic cloud. The problem of the dispersion effect in mixtures will be treated fully by Fischer in a dissertation to be published shortly and a few fundamental relations concerning this phenomenon are given. A short survey is included of several important problems connected with electrolytes to be worked out in the future. R. L.

327. Conductance of Bases in Liquid Ammonia. W. W. Hawes. *Am. Chem. Soc., J.* 55. *pp.* 4422–4430, *Nov.*, 1933.—Measurements of the electrical conductivity of sodium and potassium amides dissolved in liquid ammonia. Application of simple mass action law reveals deviations in the case of the sodium compound ; this is attributed to the small size of the ion. A. S. C. L.

328. Electrical Properties of Liquid Hydrocarbons. C. Sălceanu and D. Gheorghiu. *Soc. Române Fiz., Bul.* 35. *pp.* 103–117, *Aug.–Oct.*, 1933. *In French.*—The authors review previous work on the electrical properties of oils, essences and hydrocarbons and perform experiments to test the conclusion of Agnes that a close relation should exist between the electrical conductivity and the detonating power. The electrical conductivity is determined in terms of the rate of leakage of an electric charge through the liquid : a gold leaf electroscope being used as indicator. The rate of discharge is not constant and varies with the sign of the charge, so it appears to be doubtful if it is a true electrical conductivity which is measured. No simple relation is found between these results and the detonating properties. R. W. P.

See also Abstracts 32, 33, 118, 184, 231, 364.

DIELECTRICS AND CAPACITANCE.

329. Dielectric Constant and Ionisation Potential of Gases. A. Güntherschulze. *Zeits. f. Physik*, 86. 3–4. *pp.* 249–252, *Oct.* 31, 1933. —If $\log_{10} 1/\epsilon - 1$ or $\log_{10} 1/n^2 - 1$ (ϵ=dielectric constant) is plotted against the ionisation potential V_i the points for the inert gases lie on a straight line with remarkable exactness. The equation of the straight line is $\log_{10} 1/\epsilon - 1 = 1 \cdot 626 + 0 \cdot 1032 V_i$. The points for chemically active gases and gas forming compounds are considerably scattered round this relation. The values for the gases seem to lie on one side of the line and for vapours on the other side and do not appear to conform to any law. R. L.

330. Dielectric Properties of Chlorinated Diphenyls. A. H. White and S. O. Morgan. *Frank. Inst., J.* 216. *pp.* 635–644, *Nov.*, 1933. —As a part of the general study of the relation between dielectric properties and both chemical and physical structure, the chlorinated diphenyls are of considerable interest because of their chemical relationship to the chlorinated naphthalenes, which are widely used in condensers on account of their relatively high dielectric constant asssociated with low dielectric loss. The materials used in the investigation now described, were commercial chlorinated diphenyls differing in chlorine content and ranging from mobile oils to brittle resins. Tables of data are given for their various physical properties, and curves are included for suitable temperatures to determine the positions of the regions of anomalous dispersion. H. H. Ho.

331. Dielectric Constants. Part I. Improved Voltage Tuning Resonance Method and Its Application to Aqueous Potassium Chloride Solutions. J. G. Malone, A. L. Ferguson and L. O. Case. *J. Chem. Phys.* 1. *pp.* 836–841, *Dec.*, 1933.—An experimental study of the behaviour of various types of apparatus used in the measurement of dielectric constants of aqueous solutions of electrolytes. Although simple theory indicates that the voltage tuning method of detection should give results which are uninfluenced by the conductivity of the solutions and should, hence, be particularly adapted to measurements on electrolytic solutions, it appears, however, that other disturbing factors are present. This is shown by the divergent results obtained when different types of detection are employed and leads to the conclusion that the change in dielectric constant of such solutions as observed by this method depends more or less upon the characteristics of the particular generating and receiving circuits used. [See following Abstract.] AUTHORS.

332. Dielectric Constants. Part II. Drude Method Applied to Aqueous Solutions of Potassium Chloride. J. G. Malone, L. O. Case and A. L. Ferguson. *J. Chem. Phys.* 1. *pp.* 842–846, *Dec.*, 1933.—This paper is an experimental comparison of several adaptations of the Drude method as applied to conducting solutions. With three distinct types of detecting device, results for the dielectric constant of water and of water-alcohol mixtures agreed within experimental error. When, however, the same apparatus was applied to measurements with KCl solutions, different results were obtained with each. This indicates that any apparent change in the dielectric constant of electrolytic solutions, as observed by the Drude method, must depend in whole or in part upon the characteristics of the apparatus. [See preceding Abstract.] AUTHORS.

See also Abstracts **14, 73, 180, 234, 364.**

ELECTROCHEMISTRY.

333. Cells with Liquid Ammonia or an Ammoniacal Solution as Solvent. G. I. Costeanu. *Comptes Rendus,* 197. *pp.* 1113–1114, *Nov.* 13, 1933.—The e.m.f. of the cells $Cd|Cd(NO_3)_2,4H_2O|NH_4NO_3|AgNO_3|Ag$ and $Zn|Zn(NO_3)_2,6H_2O|NH_4NO_3|AgNO_3|Ag$ with liquid ammonia containing various amounts of water as solvent, and at various temperatures varied by only a few per cent when the percentage of water varied from 0 to 80, and the temperature from –75° to +18°. [See Abstract 740 (1933).] C. A. S.

334. Activity of Potassium in Dilute Potassium Amalgam. H. E. Bent and E. S. Gilfillan. *Am. Chem. Soc., J.* 55. *pp.* 3989–4001, *Oct.*, 1933.—Measurements have been made of e.m.f. of concentration cells of K amalgam. Partial molar free energy, heat and entropy are calculated for Hg and K. The solubility of K has been measured from 0 to 50° C. Vapour pressure measurements indicate deviations from Raoult's law. A. S. C. L.

335. Specific Effect of the Solvent in Electrolytic Dissociation. D. J. G. Ives. *Chem. Soc., J. pp.* 1360–1365, *Oct.*, 1933.—The fact that copper malonate is a very weak electrolyte compared with zinc malonate, whereas copper and zinc sulphates are electrolytes of equal strength, is attributed by Ives and Riley [see Abstract 286 (1932)] to the powerful coordinating tendency of the malonate ion, which with the help of the high localisation of charge on the copper ion, is able to break down the sheath of the water molecules normally solvating the kation. As the abnormality of copper malonate might be expected to disappear in a solvent providing a more stable solvated sheath, the effects of adding pyridine to aqueous solutions of copper malonate, oxalate and sulphate, and zinc and nickel malonates and sulphates have been examined. The results obtained show that the conductivity of the copper malonate solutions increases markedly as the concentration of pyridine increases, and support is given to the suggestion made by Ives and Riley (*loc. cit.*) regarding the breaking-down of the solvated sheath of the copper ion in aqueous solutions of this salt. The author considers that the behaviour of electrolytes of this class at least may be expressed in terms of the electron-accepting tendency of the kation and the co-ordinating tendencies of the anion and solvent, and possible modes of operation of these three factors are suggested. T. H. P.

336. Preparation of Electrolytic Iron from a Magnetic Mineral. J. J. Pittard. *Arch. des Sciences*, **15**. *pp.* 418–435, *Sept.–Oct.*, 1933.—The earlier methods for preparing iron electrolytically are reviewed and discussed. Experiments were made to obtain electrolytic iron by the use of anodes consisting of a magnetic ore of iron. The mineral was a species of magnetite, containing 79·18 % of Fe_3O_4. The electrolyte was 50 % H_2SO_4, or HCl, or a 20 % solution of a double sulphate of iron and ammonium for the anode compartment of the cell. For the kathode compartment Mohr's salt as a 20 % or 30 % solution. The mineral was unattacked by H_2SO_4, slightly attacked by HCl, but it was considered that the iron obtained was a product of the electrolysis of the Mohr's salt. The use of the mineral as a source of electrolytic iron, under the conditions investigated, was not an economic proposition. F. J. B.

337. Dissociation of Water in Lithium Bromide Solutions at 25° C. J. E. Vance. *Am. Chem. Soc., J.* **55**. *pp.* 4518–4521, *Nov.*, 1933.—From measurements of activity coefficients of HBr and known values for LiBr, the dissociation of water in LiBr solution is calculated. A. S. C. L.

338. Current Partition at the Anode in the Electrolytic Formation of Sodium Persulphate. O. Essin and E. Alfimowa. *Zeits. f. Elektrochem.* **39**. *pp.* 891–894, *Nov.*, 1933.—Study of the anodic preparation of sodium persulphate under various conditions of current density and concentration, HF concentration, and cell construction (Hg and Pt electrodes, with and without a diaphragm) has shown the equation previously derived [see Abstract 366 (1933)] to be valid. H. F. G.

339. Electrolysis of Metallic Salt Solutions with Rarefied Gas as Electrode. N. Thon. *Comptes Rendus*, **197**. *pp.* 1114–1117, *Nov.* 13, 1933.—The metal kathode is separated from the surface of the electrolyte by a variable distance, *d*, the intervening space containing only vapour from the solution. With a.c. the system electrolyte|rarefied gas|Pt has a rectifying effect, a positive current passing from liquid to metal. With d.c. a p.d. of 1000 v. with *d* 1 cm., gave 15 mA, but deposited metal on the surface of the electrolyte only when this contained a salt of a very noble metal, *e.g.*, Ag, Au, or Pt. In all other cases, including Hg and Cu, only hydrogen was evolved. Corbino's contrary observation was probably due to the electrode having been too close to the surface of the electrolyte, or to the wall of the containing vessel. The facts support Volmer's theory. [See Abstract 2212 (1932).] C. A. S.

340. Electrolysis of Sodium Through Pyrex Glass. E. W. Pike. *Rev. Sci. Instruments*, **4**. *pp.* 687, *Dec.*, 1933.—A method for introducing gas-free sodium into a vacuum tube by electrolysis through pyrex glass is described. AUTHOR.

341. Seat of E.M.F. in Voltaic Cells. M. deK. Thompson. *Am. Electrochem. Soc., Trans.* 63. *pp.* 161–163; *Disc., pp.* 163–166, 1933.—The literature is briefly reviewed. It is evident that the potential between two metals connected metallically in a "vacuum" or in a gas has nothing to do with the potential of the same metals when combined to form a voltaic cell. AUTHOR.

342. New Galvanic Element. A. Thielemann. *Zeits. f. Elektrochem.* 39. *pp.* 783–791, *Oct.*, 1933.—The capacities of a number of Pb/MnO_2 elements in various electrolytes have been determined; the best result is obtained with 2*N* HNO_3. Increased capacity is produced by using charged negative lead accumulator plates in place of ordinary lead sheet. Natural MnO_2 is better than the artificial variety, and it is an advantage to make it into a paste with graphite and magnesium and ammonium nitrate solution. A capacity of 4·6 ampere-hr. has been obtained with 12 gm. of MnO_2. Dissolution of the lead is reduced almost to zero by adding a little rodinal or glycin developer, or ammonium sulphide, to the acid. The discharge curve is considerably better than that of ordinary Leclanché dry cells, the initial e.m.f. being about 1·5 volt. H. F. G.

343. Limiting Current in the Anodic Polarisation of Metals in Aqueous Solutions. K. Schwabe. *Zeits. f. Elektrochem.* 39. *pp.* 791–799, *Oct.*, 1933.—The time-current curves have been determined at constant applied voltage for zinc anodes in 0·5*N* zinc chloride, nitrate and perchlorate solutions and in saturated zinc perchlorate solution, and for silver anodes in 0·2*N* silver perchlorate solution in propyl alcohol. The results show that limitation of the current may occur by direct formation of a thin, invisible film of solid salt on the anode, and is not due to the deposition of comparatively thick layers of salt from the electrolyte. Formation of basic salt may retard the development of a high resistance at the anode, since the metal first dissolves to form normal salt, which on hydrolysis is deposited on the electrode; the resulting impoverishment of the anode solution in ions of the metal leads to ions from the anode entering the solution rather than forming normal salt on the anode. Basic salts do not appear to be formed directly on the anode. Alternating formation and dissolution of the high-resistance salt film causes the current to exhibit periodic variations. Remarks by **W. J. Müller,** *ibid.*, 40. *pp.* 18–19, *Jan.*, 1934. H. F. G.

344. Passivity of Nickel. W. J. Müller and E. Löw. *Zeits. f. Elektrochem.* 39. *pp.* 872–879, *Nov.*, 1933.—Mainly polemical against Georgi, whose experimental results, including those of the recent work on the behaviour of nickel in electrolytes containing an oxidising agent [see Abstract 5048 (1933)] are shown to be in complete accordance with W. J. Müller's theory of passivity. H. F. G.

345. Rate of Decay of Hydrogen and Oxygen Overvoltages. G. Armstrong and J. A. V. Butler. *Faraday Soc., Trans.* 29. *pp.* 1261–1266, *Dec.*, 1933.—An expression for the rate of decay of hydrogen and oxygen overvoltages, when uninfluenced by the electromotive activity of any products of the electrolysis, is obtained. The theoretical relation has been realised for the hydrogen overvoltage at mercury electrodes, when the initial potential of the electrode was not much more negative than $\epsilon_H = -1\cdot0$ volts. It is concluded that the hydrogen formed in the electrolysis has no appreciable electromotive activity at potentials

V. 19

more negative than $\epsilon_H = -0\cdot33$. When the original potential of the electrode is considerably more negative than $-1\cdot0$ volts, much smaller rates of decay were observed, which are due to the deposition of minute amounts of metallic impurities in the mercury. At platinum electrodes, the rate of decay near the reversible hydrogen potential is considerably less than the theoretical, owing probably to the electromotive activity of hydrogen dissolved in or adsorbed on the metal. The rate of decay of the oxygen overvoltage at platinum electrodes is somewhat slower than the theoretical for the first 100 seconds, but between 100 and 1000 seconds good agreement with the theoretical rate was obtained.

AUTHORS.

346. Kinetics of Electrode Processes. Part III. Behaviour of Platinum and Gold Electrodes in Sulphuric Acid and Alkaline Solutions containing Oxygen. G. Armstrong, F. R. Himsworth and J. A. V. Butler. *Roy. Soc., Proc.* 143. *pp.* 89–103, *Dec.* 4, 1933.—Experiments are described which support the view that on the anodic polarisation of platinum electrodes in sulphuric acid or alkaline solutions a single layer of adsorbed oxygen atoms is formed. On kathodic polarisation, the reduction of the adsorbed layer occurs simultaneously with depolarisation by dissolved oxygen in the solution. When gold electrodes are polarised in dilute sulphuric acid, the formation of a definite oxide begins when the potential reaches $+1\cdot27$ volts. The efficiency of oxide formation, which is about 100 % in the earliest stages, steadily decreases as the electrolysis proceeds and finally reaches a constant value of about $0\cdot9$ %. In alkaline solutions the behaviour of gold is very similar to that of platinum, and even after long continued electrolysis the amount of oxidation is not more than corresponds with a single layer of oxygen atoms at the surface. The reduction of the oxide or oxygen films by hydroquinone has been studied. [For Part II see Abstract 2041 (1933).]

AUTHORS.

347. Technique for the Electrolytic Production of Heavy Water. H. S. Taylor, H. Eyring and A. A. Frost. *J. Chem. Phys.* 1. *pp.* 823–824, *Dec.*, 1933.—A detailed description of a method of preparing H^2H^2O in quantity is given and yields obtained over a period of months reported. [See also Abstract 4305 (1933).] AUTHORS.

348. Use of Micro-Coulometers for Transport Numbers. W. O. Reevely and A. R. Gordon. *Am. Electrochem. Soc., Trans.* 63. *pp.* 167–171, 1933.—The micro-coulometer consisted of a platinum crucible serving as kathode, a silver wire anode and a 100 gm./l. $AgNO_3$ solution. The kathode increase in weight amounted to from 20 to 35 mg. Ag. With this micro-coulometer transport numbers by the moving boundary method were determined for potassium and found to be reliable. The transport cell was similar to that of Smith [see Abstract 4043 (1931)]. AUTHORS.

See also Abstract 263.

ELECTRONS, POSITRONS AND PROTONS.

349. Existence of a Negatively Charged Proton. Structure of the Nucleus of the Hydrogen Isotope, H^2. J. J. Placinteanu. *Soc. Romåne Fiz., Bul.* 35. *pp.* 95–102, *Aug.–Oct.*, 1933. *In French.*—The author's theory is further discussed. [See Abstract 4855 (1933).]

H. F. G.

350. Interaction of Photon and Free Electron. F. Perrin. *Comptes Rendus*, 197. *pp*. 1100–1102, *Nov*. 13, 1933.—The author considers the conditions for the production of a pair of electrons, positive and negative, by interaction of a photon, not with an atomic nucleus but with a free electron. The energy of the incident photon must be at least double the minimum for the effect on a nucleus. The probability of the phenomenon is considered; the author regards its observation as possible. T. L. M.

351. Neutron and Positron. W. Bothe. *Naturwiss*. 21. *pp*. 825–831, *Nov*. 24, 1933.—Historical account of the discovery, nature and properties of the neutron and the positron. Our present concept of the fundamental particles is discussed. F. C. C.

352. Positive Electron. P. Kunze. *Phys. Zeits*. 34. *pp*. 849–857, *Dec*. 1, 1933.—Experimental investigations upon the positron are reviewed and it is shown that the evidence appears to be in favour of the view that the positron is produced by the decomposition of a photon on colliding with a nucleus. The possible rôle of a positron as a stable constituent of a nucleus is contrasted with its unstable character when existing in a space containing electrons. A Bibliography of the subject is appended. J. E. R. C.

353. Atomic Constants Deduced from Secondary Kathode-Ray Measurements. H. R. Robinson, J. P. Andrews and E. J. Irons. *Roy. Soc., Proc*. 143. *pp*. 48–60, *Dec*. 4, 1933.—New measurements have been made of the energies of the groups of homogeneous secondary kathode rays expelled from gold, tungsten, silver and copper by the K series X-rays of copper. The results are compared, in the light of recent determinations of the fundamental atomic constants, with the values to be expected from X-ray spectroscopic data, and it is shown that they are consistent with the observed value of the constant of the Compton shift and with recent work on electron diffraction, rather than with the accepted values of h and e. AUTHORS.

354. Theory of Complex Electronic Impacts. L. Goldstein. *J. de Physique et le Radium*, 4. *pp*. 576–593, *Oct*., 1933.—The quantum mechanical theory of perturbations, relating to electron binding and a first approximation of Born's method, is applied to the mechanism of complex inelastic impacts involving at least two atomic electrons. The theory thus treats the complex processes as a superposition of simple processes. The treatment is confined primarily to a first approximation of the atomic wave function, limiting the impacts to quintuple phenomena. It is shown that the probability of double, and more complex processes, is lower than that of simple processes. The application of a second approximation of the Born method, neglecting electron binding, is considered. Each method seems to have its appropriate sphere of applicability, the first when the electron binding is strong, and the second for weak binding. N. M. B.

355. Intensity of Kathode Rays Scattered by KCl. S. Shirai. *Phys. Math. Soc., Japan, Proc*. 15. *pp*. 420–427, *Nov*., 1933. *In English*.—Experimental measurements of the intensity of kathode rays scattered by KCl are shown to give results in fair quantitative agreement with the theoretical calculation of electron scattering, as in the cases of Au, Ag and Al. A. W.

356. Magnetic Deflection Method for Angular Distribution of Electrons Scattered by Gas Molecules. A. P. Gagge. *Phys. Rev.* 44. *pp.* 808–814, *Nov.* 15, 1933.—A method is given for evaluating the scattering coefficient for electrons colliding with gas molecules, if the electrons both before and after collision describe circular paths in a uniform magnetic field. As in previous methods an electron gun and a receiver are needed. The axis about which the gun may be rotated is parallel to the receiver slits and lies some distance from their common plane on a perpendicular thereto through the centre of the first slit. The second slit with Faraday collector can be set at such distances from the first slit as to collect only electrons that have lost a definite energy on collision. The chief advantage over previous methods used for angular distribution study is that, since all electronic paths are circular, the angular distribution may be studied up to 180° scattering angle. The fact that the collector may be set for electrons of definite energy allows both elastic and inelastic collisions of slow electrons to be studied. Typical experimental curves are given which show the variation with angle of the scattering coefficient in mercury vapour for 80 and 30 volt electrons. The scattering angles cover the range from 20° to 180°. These results are compared with those of previous observers over that portion of this range which they studied. An application of the method to the inelastic collisions of 23 volt electrons in mercury vapour is included. AUTHOR.

357. Diffraction of Electrons by Mica. J. A. Darbyshire. *Zeits. f. Krist.* 86. *pp.* 313–324, *Nov.*, 1933. *In English.*—Experiments on the passage of high-speed kathode rays through thin slips of muscovite mica are described, and a table is given indicating the variation of the effect with the thickness, measurement of thickness being made by means of the Michelson interferometer. Also the nature of the patterns obtained when the rays are reflected from a freshly cleaved slip of mica are discussed, and an explanation is given for the pseudo-symmetrical effects observed as the azimuth is changed. AUTHOR.

358. Structure of Thin Celluloid Films. Part II. E. T. Jones. *Phil. Mag.* 16. *pp.* 953–961, *Nov.*, 1933.—In continuation of previous work upon the diffraction of electrons by thin celluloid films [see Abstract 5444 (1933)] additional patterns obtained under the same conditions but with different specimens of celluloid are described. The patterns show evidence of being due to electrons diffracted by two superposed layers in the film, the lattices of which are inclined to one another. J. E. R. C.

359. Orientations of Thin Evaporated Metallic Films by Electron Diffraction Method. K. R. Dixit. *Phil. Mag.*, 16. *pp.* 1049–1064, *Dec.*, 1933.—The work was undertaken to investigate chiefly the effect of temperature on the orientations of the small crystals in thin metallic films. The films, $10^{-4}-10^{-6}$ cm. thick, of silver on molybdenum, quartz, and glass, of aluminium on molybdenum, and of zinc on molybdenum have been studied over the whole range of temperatures above the room-temperature. Different orientations have been observed which do not depend on the nature of the base. A theory is proposed that these thin deposits behave as a two-dimensional gas. AUTHOR.

See also Abstract 20.

ELECTROSTATICS.

360. Effect of Heat Treatment on Production of Frictional Electric Charges on Metals. P. A. Mainstone. *Phil. Mag.*, 16. *pp.* 1083–1096, *Dec.*, 1933.—Prolonged heating of aluminium and nickel at very low pressures is shown to produce a considerable lowering of the normal negative frictional charge, with a partial slow recovery after the metal surface has been re-cooled. A similar effect is found on heating these metals in nitrogen at atmospheric pressure. Widely varying results may be obtained after de-gassing the metal and re-heating it at about 300° C. in hydrogen or nitrogen. Re-polishing or etching, however, very largely restores the surface to its original state. The frictional charge on polished palladium changes sign from negative to positive when the metal is de-gassed and heated in hydrogen at about 250° C. The results are discussed in the light of experimental and theoretical work on absorption, as well as in relation to the contact theory of tribo-electricity. AUTHOR.

361. Contact Potentials and the Effects of Unimolecular Films on Surface Potentials. Part I. Films of Acids and Alcohols. W. D. Harkins and E. K. Fischer. *J. Chem. Phys.* 1. *pp.* 852–862, *Dec.*, 1933.—Simultaneous measurements of film pressure and surface potential indicate that at pressures above that of the gaseous films, organic substances with homo-heteropolar molecules give a single smooth curve for the relation between surface potential and molecular area. For areas sufficiently great to reduce the pressure to that of the gaseous film the surface potential is variable until the area becomes so great that the " continents " and " islands " of condensed film evaporate to give a gaseous film alone. The surface potential increases rapidly with increase of the number of carbon atoms in the hydrocarbon chain, and is about 400 mV. for condensed films of stearic acid. It is higher for alcohols than for acids with the same number of carbon atoms. The surface potential increases with decrease of temperature, with increase of concentration, and by replacement of a basic by an acid solution. In the condensed state the films exhibit hysteresis effect both with respect to film pressure and surface potential. Dipole moments calculated by Helmholtz's equation are about 1/6 as large as those found by ordinary methods. J. S. G. T.

362. Sensitivity of the Compton Electrometer for Measurement of Charge. F. Wolf. *Ann. d. Physik*, 18. 4. *pp.* 373–384, *Oct.*, 1933.—A theoretical investigation to find how the Compton electrometer can be made a sensitive instrument to measure charge. The various factors are examined practically and the maximum charge which can be measured when the mechanical limits are reached is : 5 mV. cm./scale div. or 34,900 elementary quanta per scale division. Exactitude of measurement is increased when the electrostatic part is made slightly astatic and only small capacities are used. H. M. B.

See also Abstract 341.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

363. Crystal Structure and Electrical Properties. Part III. Lattice Structure and Conductivity of Single Crystals of Bismuth Magnetised Longitudinally. O. Stierstadt. *Zeits. f. Physik*, 85.

V. 19

11–12. *pp.* 697–707, *Oct.* 14, 1933.—In previous papers [see Abstract 5066 (1933)] the variation with crystal orientation of the change of electrical conductivity, due to transverse magnetisation, was studied and shown to reveal the crystal structure of the specimen (Bi). When longitudinal magnetisation is employed (current and field in the same direction) rotation of the single crystal about the current direction yields nothing. It is possible, however, to study series of crystals for which a particular lattice plane occupies different orientations with respect to the current direction, and experiment shows that the measured change in conductivity due to magnetisation again is closely correlated with the lattice structure. W. S. S.

See also Abstract 313.

MAGNETISM AND ELECTROMAGNETISM.

364. Inverse Boundary Value Problem in Electrodynamics. L. B. Slichter. *Physics*, 4. *pp.* 411–418, *Dec.*, 1933.—From knowledge of the electromagnetic field at the surface of a half-space due to a prescribed oscillatory source, is determined the unknown variation with depth of the conductivity and the dielectric constant. Unique solutions exist for these quantities. AUTHOR.

365. Law of Discontinuous Distribution of Ferromagnetic Curie Points. Part IV. Variation of the Curie Point in Metallic Solid Solutions. R. Forrer. *J. de Physique et le Radium*, 4. *pp.* 501–512, *Sept.*, 1933.—The above law is applied to the variation of θ in alloys in solid solution. The linear character of the variation of the number of contacts [see Abstract 5453 (1933)] with the percentage content is used to support the hypothesis that the number of contacts is proportional to the square of the Curie point temperature. G. E. A.

366. Barkhausen Effect at the Curie Point. O. Tesche. *Phys. Zeits.* 34. *p.* 879, *Dec.* 1, 1933.—A wire placed symmetrically at the centre of a ring coil and made of ferromagnetic material is heated by a.c. and permits observations to be made on the establishment of the Barkhausen effect up to above the Curie point. The disappearance of the effect as transit through the point is effected is also noted. The demonstration is illustrated by experiments on iron, nickel, cobalt and various kinds of steel. S. G. B.

367. Magnetic Analysis of Nickel Films Deposited by Evaporation. H. N. Otis. *Phys. Rev.* 44. *pp.* 843–849, *Nov.* 15, 1933.—The magnetic properties of nickel films deposited from vapour on surfaces at several temperatures and, in some cases, annealed to various degrees have been studied at room-temperature. Films deposited at room-temperature are magnetically hard, having low initial susceptibility (χ_0). For films deposited on a metal with a higher coefficient of linear expansion than nickel, raising the temperature of deposition or annealing at higher temperatures increases χ_0. For films on a metal with a lower coefficient of linear expansion than nickel χ_0 first increases with deposition or annealing temperature but decreases upon high-temperature annealing. The results are explained on Becker's theory by assuming that the films are deposited under strain, these deposition strains becoming less at higher temperatures. AUTHOR.

368. Ferromagnetism of Nickel Colloids. S. R. Rao. *Phys. Rev.* 44. *pp.* 850–853, *Nov.* 15, 1933.—Colloidal nickel was prepared by an electrical dispersion method and tested magnetically. The intensity of magnetisation of the colloid at particle diameters less than about 1·5μ was found to be below that of the mass metal. This experimental result is discussed in the light of Heisenberg's and Bitter's theories of ferromagnetism.
AUTHOR.

369. Diamagnetism of Organic Compounds with Reference to the Influence of Temperature and Constitution. Part I. Primary Alcohols, Nitrobenzene, and *m*-Cresol. B. Cabrera and H. Fahlenbrach. *Zeits. f. Physik,* 85. 9–10. *pp.* 568–591, *Sept.* 30, 1933.—The susceptibilities of methyl, ethyl, hexyl, octyl, and dodecyl alcohols, nitrobenzene, and *m*-cresol in the interval −50—+130 C°, and of propyl and butyl alcohols at room-temperature are independent of temperature at values of the latter sufficiently removed from the melting point. In the neighbourhood of the melting point large variations occur in some cases, probably as a result of changes of association, whilst at the melting point there is always a sharp rise. The molecular susceptibilities of the alcohols conform to Paschen's additive law, but the derived values for hydrogen and hydroxyl do not agree with the observed susceptibility of water, owing probably to the disturbing influence of the carbon or oxygen atoms.
H. F. G.

370. Paramagnetism. W. J. de Haas and E. C. Wiersma. *K. Onnes Lab., Leiden, Comm. Nos.* 217–228. *Suppt. No.* 74*b*. *pp.* 36–70, 1933. *In French.*—An account of investigations made on gases and solids. In general the results agree with those predicted by theory. The moments indicated by Bose and Stoner for salts of the iron group are verified. There are deviations, on the other hand, in the case of members of this group with the highest atomic numbers. In the group of rare earths, the greater part of the research deals with the question of odd and even numbers of electrons in the ion. [See Abstract 1665 (1931).] G. E. A.

371. Recent Researches on Paramagnetism and Atomic Moments. G. Foëx. *J. de Physique et le Radium,* 4. *pp.* 517–532, *Sept.,* 1933.—The variation of magnetic susceptibility with temperature is discussed with regard to certain metals and salts from the standpoint of the laws of Curie and Weiss. Using the latter relation moments are calculated for the rare earth and iron families, and the effect of change of state considered. Curves are given in many instances. W. R. A.

372. Magnetic Deflection of Hydrogen Isotopic Molecules and the Magnetic Moment of Deutons. L. Estermann and O. Stern. *Zeits. f. Physik,* 86. 1–2. *pp.* 132–134, *Oct.* 17, 1933.—The Stern-Gerlach experiment is performed with molecular rays obtained from the hydrogen liberated from a 0·1 gm. sample of water, the hydrogen in which contained 82 % of the heavier isotope H^2. The preliminary magnetic deflection experiments indicate that the magnetic moment of the nucleus of H^2 (the deuton) is not greater than the magnetic moment of the proton and may be slightly smaller in spite of the fact that the mechanical moment of the deuton is twice as large as that of the proton. J. E. K.

373. Magnetic Susceptibility of the Free Radical $C_{14}H_{14}O_3N$ and Comparison with van Vleck's Theory. F. Galavics. *Helv. Phys. Acta,* 6–7. *pp.* 555–564, 1933. *In German.*—The paramagnetic susceptibility of the free radical is measured between the temperatures 19° and

V. 19

51° C., and the values found agree with those calculated from van Vleck's formula. G. E. A.

374. Volume Magnetostriction in Poly- and Mono-crystalline Bodies. O. v. Auwers. *Phys. Zeits.* 34. *pp.* 824–827, *Nov.* 15, 1933.—The present work is an experimental study of the relationship of magnetostriction to field strength, etc., for the volumes of single and polycrystals, in order to interpret the theory of magnetisation in ferromagnetic bodies with regard to their lattice structure. Single crystals of the Fe-Ni series and polycrystals of the Fe-Co-Ni series of alloys were examined. The results may be summarised as follows: (1) The volume effect below the technical saturation value is, to a first approximation, negligible; (2) above the technical saturation value the volume effect is directly proportional to the strength of the external field; (3) the slope of the line expressing this proportionality is independent of the orientation of the direction of crystal lattice to the field direction; (4) the extrapolated value of $H_{(0)}$, *i.e.*, the point of intersection with the abscissa, by this line, is smaller, the closer the direction of magnetisation is coincident with the direction of least magnetisation in the crystal lattice; (5) the inclination of the line from (2) is strongly influenced by the chemical nature and composition of the crystal lattice. The volume effect was also measured for a complete system of Fe-Co-Ni alloys of a polycrystalline nature. The characteristic perminvar alloys lie on the average within a broad saddle-shaped band, and their small magnetostriction is illustrated by the results. Between the volume magnetostriction and the structure diagram there is clearly a very close relationship. S. G. B.

375. Torsion Magnetometer for Thin Ferromagnetic Specimens. H. N. Otis. *Rev. Sci. Instruments*, 4. *pp.* 681–683, *Dec.*, 1933.

See also Abstracts 38, 52, 71.

MEDICAL RADIOLOGY AND ELECTROLOGY.

376. Selective Heating of Tissues by Ultra-Short Waves. N. N. Malov. *Phys. Zeits.* 34. *pp.* 880–883, *Dec.* 1, 1933.—The quantity of heat generated in a dielectric placed between the plates of a h.f. wave generator is calculated. This quantity has a maximum value $1/2\sigma$ when $\sigma = Ec/2\lambda$, where σ is the conductivity and E the dielectric constant. It is shown that for the organs of the human body, more marked selective heating effects and greater absolute amounts of heat evolved, can be obtained with comparatively long waves (7–20 m.) than with the very short waves recently introduced. These advantages are enhanced by the greater simplicity of the longer wave apparatus. J. E. R.

377. Radiographic Measurement of Length and Breadth. W. Watson. *Brit. J. of Radiology*, 6. *pp.* 630–633, *Oct.*, 1933.—Describes a method whereby dimensions may be accurately recorded and measured radiographically by satisfying the condition that the beam of X-rays used shall be always at the same angle to the photographic film. This condition is secured by using a narrow beam of X-rays, limited by a suitable slit, and traversing the entire tube along the object to be measured. In certain cases, *e.g.*, bones, only the two ends need be radiographed. The resulting radiographs have practically the same dimensions as the object. G. E. B.

378. Physical Foundations of Chest Roentgenography. Part III. R. B. Wilsey. *Am. J. of Roentgenology and Radium Therapy,* 30. *pp.* 523–528, *Oct.,* 1933.—Continues previous papers respecting investigation of the physical aspects of X-ray examination of the chest, to determine the optimal technique. The first paper dealt with the optical conditions, and the second with the effect of movement of the lungs and the size of the focal spot of the X-ray tube as respects sharpness of image [see Abstract 5473 (1933)]. The present paper deals with factors determining the contrast of the radiograph, as defined by differences in photographic density, in different areas of the film. Contrast should not be too great, as this affects detail. Data are given with reference to the relation of X-ray intensity to blackening of the film, for low and high voltages, as measured by an aluminium graduated test object. The effect of scattered radiation is considered and it is pointed out that the proportion of scattered radiation is less in the chest than in thicker portions of the body. Although the Potter-Bucky apparatus necessitates increase of the time of exposure with future adaptation, its use is recommended. B. J. L.

379. Intensity Measurements with Artificial Sources of Ultra-Violet Light. A. van Wijk and E. H. Reerink. *Physica,* 13*e.* 9. *pp.* 289–298, 1933.—The biological activities of different sources of ultraviolet radiation may be compared by means of photoelectric and photochemical methods only when the energy distributions of the sources are the same. The need of studying the wave-length-sensitivity curves of photobiological processes is emphasised. Methods of determining energy distribution-wave-length curves are described, and a brief account is given of lamps which emit most of their energy in widely spaced lines.

H. F. G.

380. Energy Considerations in Medium and High-Voltage Therapy. C. C. Lauritsen. *Am. J. of Roentgenology and Radium Therapy,* 30. *pp.* 529–532, *Oct.,* 1933.—Previous calculations of energy per röntgen [see Abstract 5475 (1933)] are extended to regions of the X-ray spectrum where photoelectric absorption, neglected in previous work, becomes of importance. Calculated values are given for X-ray energy, corresponding from 20 to 1000 kV and the energy of the erythema dose is calculated on certain assumptions and plotted against equivalent voltage. The curve shows a distinct minimum at 80 kV. The importance of the erythema dose in practical radiology is emphasised and it is pointed out the dosage must be determined by use of a large beam and the total energy, for one erythema dose, increases rapidly with voltage and filtration. This increase, together with the increase of depth dose, is considered evidence of the superiority of hard radiation in deep therapy. B. J. L.

381. Detection and Estimation of Radium in Living Persons. H. Schlundt, J. T. Nerancy and J. P. Morris. *Am. J. of Roentgenology and Radium Therapy,* 30. *pp.* 515–522, *Oct.,* 1933.—In March, 1931, injections of soluble radium salts were given intravenously to selected dementia patients; radium chloride in 10 microgram doses, in isotonic sodium chloride solution, being used. Tests were taken of the radioactivity of these persons by the γ-ray and radon estimation methods at intervals of six months. Reference is made to work by Barker and Schlundt upon the same subject. The experimental methods of determining the amount

V.
19

of radium from the γ-ray measurements and by measurement of the radon in the expired air are given in detail. The clinical aspects are also discussed and, of 32 patients, 21 showed no improvement and 11 cases showed improvement. B. J. L.

382. Valve Amplifier for the Detailed Study of Radium Isodose Curves. G. Goldhaber and H. D. Griffith. *Brit. J. of Radiology*, 6. *pp.* 656–665, *Nov.*, 1933.—A balanced valve amplifier is described for use with a graphite ionisation chamber of 3 c.mm. volume. Measurements were made of the intensity distribution at distances between 3 mm. and 15 mm. from the centre of radium preparations. The results indicate that the simple Sievert formulæ for intensity distribution are, to a close approximation, applicable. AUTHORS.

See also Abstracts 231, 285.

OSCILLATIONS.

383. Forced Oscillations of Electron Clouds in Dense Gases. K. K. Darrow. *Rev. Sci. Instruments*, 4. *pp.* 563–569, *Nov.*, 1933.—An account is given of the behaviour of conducting gases subjected to h.f. electrostatic fields. The observed phenomena can be interpreted, in many cases with striking success, by supposing that the free electrons wandering in the gas are set in motion by the field and oscillate and drift according to laws which can be derived from knowledge of the response of free electrons to steady fields. When a constant magnetic field coexists with the h.f. forces, the phenomena become more complicated, but are still predictable. There are also peculiar phenomena indicating that the electrons in a conducting gas have certain natural frequencies of oscillation. Applications are made to the absorption of radio-frequency waves in ionised gases. A. W.

384. Association of Ionic Oscillations with the Negative Glow and Anode Glow. K. G. Emeléus and A. H. Gregg. *Phil. Mag.* 16. *pp.* 1079–1082, *Dec.*, 1933.—Some cold kathode glow discharges have been examined for ionic oscillations. None have been found to originate in the negative glow and Faraday dark space, and it is pointed out that this may be connected with the fact that the proper frequencies of the ionised system vary from point to point continuously. Earlier observations that localised anode spots oscillate have been confirmed and tentative explanations of this put forward. AUTHORS.

385. Measurement of Decay of Oscillations in an Oscillatory Circuit. G. W. Brindley. *Journ. Sci. Instruments*, 10. *pp.* 393–394, *Dec.*, 1933.—The apparatus consists of an inclined plane of accurately parallel stainless steel rails. The rails are divided into three sections, section A being 5 ft. 3 in. long, section B being 6 in. long, the length of the final section, C, being immaterial. A steel ball (ball bearing) 2½ in. dia. runs down the rails and thereby makes contact between the various pairs of rails in turn. By varying the inclination of the plane or by starting the ball at a different point, the time taken by the ball to cross an ebonite strip between A and B may be varied. In order to study the decay of electric oscillations, the primary of an induction coil was connected through rails A, the secondary circuit being connected to a condenser which was connected through rails B to a ballistic galvanometer. The ball, when rolling down section A, completes the primary circuit; this is broken when the ball runs over the ebonite strip, and the condenser is discharged when the ball runs on to rails C, causing a throw of the galvanometer. By starting the ball from different positions on A, curves representing condenser voltage plotted against time may be obtained. The apparatus may also be used for measuring resistances by the leakage method. G. E. B.

386. Chemical Reactions under the Influence of Oscillating Circuits. A. de P. Forjaz. *Comptes Rendus,* 197. *pp.* 1124–1125, *Nov.* 13, 1933.—Oscillating circuits appear to play the rôle of catalysts in the ageing of wine, lowering of acidity in oils, in ionisations and in allotropy; a new chemical and industrial field is thereby presented. H. H. Ho.

See also Abstracts 60, 172.

PHOTOELECTRICITY.

387. Photoelectric Sensitisation of Cæsium. W. Kluge. *Phys. Zeits.* 34. *pp.* 844–846, *Nov.* 15, 1933.—The sensitisation of Cs by the passage of a glow discharge in hydrogen results in a strong enhancement of the photoelectric emission with a shift of the threshold to about 700 $m\mu$ from about 600 $m\mu$. The sensitivity curve has not the same bell shape as those of Na, K and Rb when similarly treated; this is attributed to the influence of the silver on which the Cs is deposited. In kathodes of the type $Ag - Cs_2O - Cs$ the sensitivity is much greater if the silver surface is rough than if it is a mirror, thresholds as long as $1 \cdot 4\,\mu$ being sometimes obtained in the former case, as against $1 \cdot 0\,\mu$ in the latter. A maximum of emission is found at about 290 $m\mu$ in addition to the already known maxima at about 370 $m\mu$ and in the near infra-red. These two short-wave maxima are also found when Cu, Ni or Au are substituted for Ag. In kathodes of the type $Ag - Cs_2O$ these two short wave maxima still appear, although the threshold occurs at 480 $m\mu$. The author suggests that the visible and infra-red emission of kathodes of the type $Ag - Cs_2O - Cs$ is a property of the Cs layer, but that the ultra-violet emission is due to the underlying surface. D. H. F.

388. General Properties of Photoelectric Kathodes. G. Déjardin. *R.G.E.* 34. *pp.* 515–526, *Oct.* 21; 555–566, *Oct.* 28; 591–607, *Nov.* 4, *and pp.* 629–637, *Nov.* 11, 1933.—A comprehensive survey of the general properties of photoelectric cells of the electronic emission type is undertaken. The variation of current with applied potential both for cells with a central kathode and with a central anode, and the proportionality between the intensity of the light incident on the cell and the resulting current are dealt with at length. Curves showing the relative sensitivity to light of different wave-lengths are given for kathodes of alkali metals deposited in bulk; of alkali metals deposited in thin films on specially prepared bases of various kinds; of alkali metals sensitised by the vapour of various substances; and of barium. Figures for the sensitivity to white light are given for most of these kathodes. The effect on these properties of placing screens, particularly fluorescent screens, in front of the cells is discussed. Factors which influence the response of cells are dealt with. In conclusion, the trend of research on the selective photoelectric effect is discussed. D. H. F.

389. Photoelectric Light-Receivers. J. H. de Boer. *Physica*, 13*e*. 9. *pp*. 285–288, 1933.—Photoelectric kathodes, consisting of a base-metal (silver) covered by a salt- or oxide-layer, to which atoms of Cs are adsorbed, have a great sensibility in the infra-red region of the spectrum. When struck by light, the adsorbed Cs atoms give off electrons and remain ions themselves. These ions must be neutralised by electrons coming from the base-metal. In relatively thick Cs_2O layers Cs atoms have been brought into the layer to facilitate this neutralisation. The neutralising electrons, however, do not pass the oxide layer without difficulties; in some cases they stick there and form a negative space-charge. The kathode will then show the phenomenon of fatigue. To cure the kathodes from this fatigue, it is necessary and sufficient to loose the electrons from the places where they have stuck. They will loose themselves, when the kathode is not used for some time; the process can be accelerated by heating, or by irradiation with infra-red light. When used in infra-red light the kathode will not show any fatigue at all. A. D.

390. Prediction of the Photoelectric Effect by Atomic Indices Associated with a Substance. H. Spindler and R. Coustal. *Comptes Rendus*, 197. *pp*. 982–984, *Oct*. 30, 1933.—By making use of atomic indices, assigned to elements according to a scheme of classification suggested by one of the authors, it is predicted that CuI and CuCl will not exhibit the photoelectric effect towards visible light after the manner ot Cu_2O, but that CuBr should do so. Experiments made with cells of these substances, constructed identically, bear out these predictions, the sensitivity of the CuBr cell being 0·6 of that of a good Cu_2O cell. Under certain conditions the intensity of the current in the CuBr cell is proportional to the luminous flux received, but when the cell has been used for some time it gradually loses its properties. H. L. B.

391. New Advances in Blocking-Layer Photoelectric Cells. F. Rother and H. Bomke. *Phys. Zeits*. 34. *pp*. 865–870; *Disc*., 870, *Dec*. 1, 1933.—In connection with the preparation of Cu_2O layers for photoelectric cells and rectifiers, experiments are made upon the effect of covering the original copper plate, before oxidation, with a thin layer of another metal (Ag, Sn, Au, Pt, Rh, Pd, Co and Ni were tried). It is found that oxide layers prepared after this treatment are specially suitable for use in blocking-layer photoelectric cells, the efficiency obtained being considerably greater than with cells of the usual types. It is noted that the temperature coefficient of the cells can also be influenced by suitable choice of the metal of the intermediate layer. The results are discussed in the light of the diffusion theory previously put forward by the authors. [See Abstract 3258 (1933).] L. A. W.

See also Abstracts 170, 353.

PIEZOELECTRICITY.

See Abstract 52.

THERMIONICS.

392. Simple Material Constants in Calculation of Exit-Work. F. Rother and H. Bomke. *Zeits. f. Physik*, 86. 3–4. *pp*. 231–240, *Oct*. 31, 1933.—A formula based on the Sommerfeld-Fermi theory of metallic electrons is found to be in good agreement with all experimental results for the energy required to liberate electrons from metals. The calculation is extended to several metals for which no practical results have yet been obtained. The theoretical method is discussed with regard to non-conductors and the necessary energy is found to be such that photoelectrons would only be released by waves in the Schumann part of the spectrum. Thus it is unlikely that practical and theoretical results will agree well. H. M. B.

393. Thermionic Constants for Platinum. H. L. van Velzer. *Phys. Rev.* 44. *pp.* 831–836, *Nov.* 15, 1933.—The thermionic constants for platinum in the form of cylindrical filaments were investigated. The slope of the supersaturation curves was taken as a criterion of filament condition. It was found that a very stable state, probably not indicative of a pure surface was obtained which withstood ageing at 1650° K. for 175 hours. For this condition the ϕ and A values are very high. Ageing at 1785° K. produced a new surface for which the supersaturation slopes were correct, and for which the constants were assumed to be approaching correct values. If A is taken to be 60 amperes/$cm.^2 \cdot deg.^2$, ϕ is estimated to be 5·29 volts. AUTHOR.

394. Field Electron Emission from Liquid Mercury. J. W. Beams. *Phys. Rev.* 44. *pp.* 803–807, *Nov.* 15, 1933.—Field emission from liquid mercury has been investigated by applying an impulsive potential of approximately 10^{-6} sec. duration between a spherical steel anode and a plane mercury kathode. The field just necessary to produce breakdown gave a measure of the field necessary to produce emission because rotating mirror photographs showed that the field emission from the kathode initiated the discharge. The liquid mercury kathode was cooled to a few degrees above its freezing point and the mercury vapour pressure still further reduced by solid CO_2 traps. The mercury could be distilled repeatedly *in vacuo* and the surface of the kathode changed by "overflowing." The electric field necessary to produce sufficient field emission to start the discharge depended upon the purity of the mercury surface. It varied from $3 \cdot 5 \times 10^5$ volts per cm. for impure mercury to $1 \cdot 8 \times 10^6$ volts per cm. for mercury that had been repeatedly distilled *in vacuo*. AUTHOR.

See also Abstract 316.

THERMOELECTRICITY.

395. Electrothermal Homogeneous Effect in Liquid Metals. C. Benedicks and G. Siljeholm. *Arkiv f. Mat., Astron., och Fysik,* 23*A*. 27. *pp.* 1–21, 1933. *In German.*—A description is given of experiments carried out with different sets of apparatus in order to test the existence of a heat action proportional to the strength of current flowing in a homogeneous conductor kept at the same temperature which was previously affirmed by Benedicks. This is called the "electrothermal homogeneous effect" or "X-effect," and is the converse of the thermoelectric homogeneous effect or "Benedicks effect." When precautions were taken to eliminate the disturbance due to the simultaneously occurring spontaneous Thomson effect the existence of the effect examined was confirmed. Experiments were made with pure Ag and with Tl and Cd amalgams. J. J. S.

See also Abstract 312.

V. 19